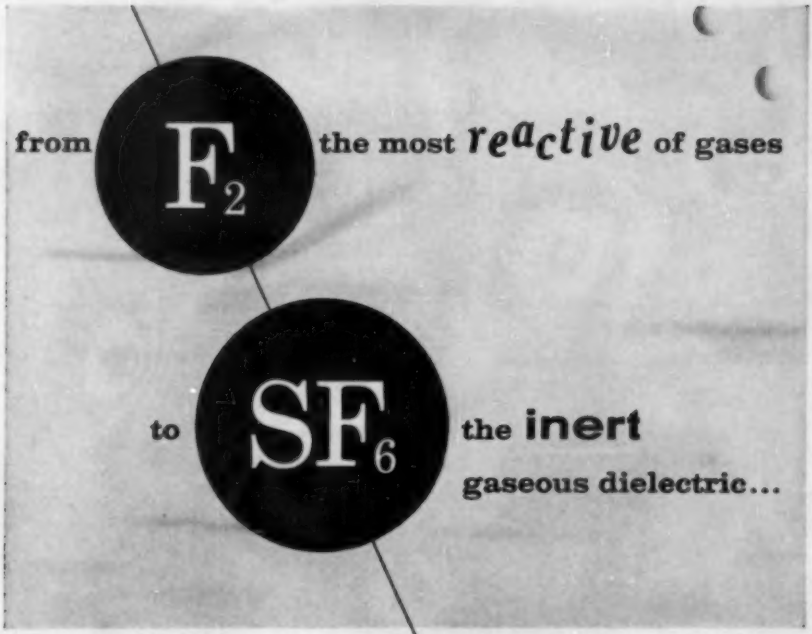
June, 1956

THE CHEMIST

VOLUME XXXIII NUMBER 6

Raymond Stevens, Hon. AIC
Receives AIC Gold Medal

(See Page 199)



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Publication of

THE AMERICAN INSTITUTE OF CHEMISTS, INC.

60 East 42nd street, New York 17, N. Y.

Entered as second class matter April 8, 1936 at the Post Office at New York, N. Y., under Act of August 24, 1912. Issued monthly.

Subscription price, $2.00 a year to Members, $3.00 to Non-Members. Single copy, this issue, $0.25. Copyright, 1956 by THE AMERICAN INSTITUTE OF CHEMISTS, INC.

Volume XXXIII June, 1956 Number 6

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SCHEDULED FOR EARLY PUBLICATION

Sixteen Years of Chemical Education in China, Dr. Peter P. T. Sah
Should Consulting Engineers Advertise? (Reprint), Richard L. Moore, F.A.I.C.
Award of New Jersey AIC Chapter Honor Scroll to H. F. Wakefield, F.A.I.C.
Award of Western AIC Chapter Honor Scroll to George Parkhurst.
Washington Chapter Honor Scroll to Dr. B. Van Evera, F.A.I.C.
Louisiana Chapter Honor Scroll to H. A. Levey, F.A.I.C.
New York Chapter Honor Scroll to Dr. C. N. Frey, F.A.I.C.
Annual Reports of AIC Chapters and Committees
The Federal Government and Education, Dr. Benjamin Van Evera, F.A.I.C.
Let's Talk About Your First Job, Dr. Ray P. Dinsmore, Hon. A.I.C.
Professional Recognition, Dr. Ray P. Dinsmore, Hon. A.I.C.
The Future of the AIC. Dr. Ray P. Dinsmore, Hon. AIC.
Communications Between Older and Younger Professionals, Francis J. Curtis, Hon. AIC.
What Management Expects of the Chemist, George L. Parkhurst
Communications: The Chemist's Viewpoint, Dr. Johan Bjorksten, F.A.I.C.

Proceedings of the 33rd Annual AIC Meeting. Theme: Communication.

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TO COME IN JULY

Dr. Ray P. Dinsmore, retiring AIC president, offers a thoughtful paper on the "Future of the AIC", pointing out opportunities for service. The "human interest" story will be about the award of the Honor Scroll to Dr. Benjamin D. Van Evera, professor, The George Washington University. His acceptance address concerns "The Federal Government and Education." Not all the excellent papers on communication, presented at the 33rd Annual Meeting, were available for the June Chemist. One to appear in the midsummer month is by Francis J. Curtis, Hon. AIC, vice president of Monsanto Chemical Co.

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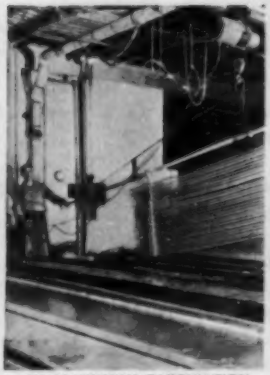

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IN AGRICULTURAL CHEMICALS

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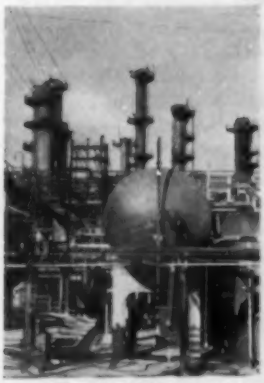

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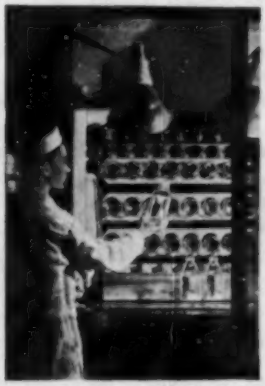

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EDITORIAL

Communicate or Croak

Dr. D. B. Keyes, F.A.I.C.
AIC Councilor; Former AIC President.

THE truly professional person is an *individual,* an independent thinker who has dedicated his life to help others and not himself. He cannot be classified or regimented. He communicates with *his fellows,* primarily to learn and not to "preach," thus increasing his own knowledge and competence. These are the individuals who join the INSTITUTE.

If you are *not* an independent thinker; if you want to help yourself and *not* others; if you love to harangue the masses and *not* listen to your fellows; and if you do *not* mind being regimented by your "betters," join a union and do your croaking on the picket line. You will have fun!

Dr. James B. Conant, Hon. AIC, some years ago, is said to have stated: . . . "reformers must examine every action, lest they end by placing in power the greatest tyrant of all — organized society."

SPECIAL ANNOUNCEMENTS

Election Results

WE look forward to another year of continuing progress under the following officers and councilors who were elected by the members of THE AMERICAN INSTITUTE OF CHEMISTS to take office following the 1956 Annual Meeting:

President, John H. Nair, Assistant Director of Research, Thomas J. Lipton, Inc., 1500 Hudson St., Hoboken, N. J.

President-elect, Dr. Henry B. Hass, President, Sugar Research Foundation, Inc., 52 Wall Street, New York 5, N. Y.

Secretary (re-elected), Dr. Lloyd Van Doren, The American Institute of Chemists, Inc., 60 E. 42nd St., New York 17, N. Y.

Treasurer (re-elected), Dr. Frederick A. Hessel, Commercial Research Manager, General Aniline & Film Corp., New York 14, N. Y.

Councilors-at-Large (three-year terms), Dr. Harry L. Fisher (re-elected), Professor of Chemical Engineering in Rubber Technology, University of Southern California, Los Angeles 7, Calif.; Dr. Donald B. Keyes, Consultant, Arthur D. Little, Inc., 420 Lexington Ave., New York 17, N. Y., and Dr. Sidney

D. Kirkpatrick, Editorial Director, *Chemical Engineering* and *Chemical Week*, 330 W. 42nd St., New York 36, N. Y.

Councilor-at-Large (two-year term), Dr. Austin W. Fisher, Jr., Head, Process Engineering Department, Arthur D. Little, Inc., Cambridge 42, Mass.

Honorary Membership Presented

EACH year the Gold Medalist for the year is also presented with Honorary AIC Membership. So Raymond Stevens, Medal recipient for 1956, was presented with the certificate of honorary membership at the conclusion of the Annual Business Meeting held on May 10th. Dr. Ray P. Dinsmore, retiring AIC president, made the presentation. The citation reads:

To Raymond Stevens

in recognition of his contributions to the wider understanding of essential procedures for the management and operation of industrial research.

New Honorary Members Chosen

AT the INSTITUTE Luncheon held May 11th at the AIC Annual Meeting in Boston, Mass., John Kotrady of the Beacon Laboratories of The Texas Company, chairman of the Committee on Honorary Membership, announced that the following persons had been chosen to receive Honorary AIC Membership at ceremonies sometime during the fiscal year 1956-1957:

Dr. Joel H. Hildebrand, Emeritus Professor, University of California, Berkeley, Calif.

Lawrence H. Flett of New London, New Hampshire, former preident of THE AMERICAN INSTITUTE OF CHEMISTS.

Dr. W. George Parks, Head, Department of Chemistry, University of Rhode Island, Kingston, R. I., and Director of the Gordon Research Conferences.

These certificates of Honorary Membership will be presented at meetings and dates to be announced later.

Gold Medal Nominations Requested

DR. Lincoln T. Work, former AIC president, is now the chairman of the Committee on Gold Medal Award. He requests members of THE AMERICAN INSTITUTE OF CHEMISTS to send to him, at 420 Lexington Ave., New York 17, N. Y., the names of persons who are deserving of this award. The AIC By-laws specify that the award shall be made for "noteworthy and outstanding service to . . . the profession of chemist or chemical engineer in

in the United States of America." These nominations will be carefully considered by the Committee in making its selection of the person to receive the 1957 Gold Medal.

Niagara Chapter Honors Dr. Furnas

THE Niagara Chapter of THE AMERICAN INSTITUTE OF CHEMISTS has awarded its 1956 Honor Scroll to Dr. Clifford C. Furnas, Assistant Secretary of Defense for Research and Development, for his many years of distinguished service to academic and applied science. The presentation will be made at the Chapter's June 29th meeting.

AAAS Affiliation

THIS Spring, the AIC obtained affiliate status with the American Association for the Advancement of Science. This entitles the AIC to appoint two representatives to the Council of the AAAS. These representatives, chosen by the AIC Council, are the president-elect, Dr. Henry B. Hass, and the Secretary, Dr. Lloyd Van Doren.

This affiliation with the AAAS also entitles Fellow members of the AIC to become AAAS Fellows, if they desire, in accordance with the qualification that, "A person who holds the indicated class of membership in one or more of the following societies is deemed to have met requirements of, and is eligible for automatic election as, a Fellow of the AAAS. . . The American Institute of Chemists — Fellows. . . " AIC Fellows who desire such status should write to the Business Office of the AAAS at 1025 Connecticut Ave., N.W., Washington 6, D.C.

Employment of Chemists over Forty

AT the National AIC Council meeting at Boston, the Chicago AIC Chapter requested that a study of the employment of chemists who are over 40 be considered. This was referred to the Manpower Committee.

Dr. George L. Royer, chairman of the Committee, asks for information and comment on the subject. The committee welcomes examples of chemists who have and have not had difficulty in finding jobs at older ages. It will also appreciate comments or suggestions as to what needs to be and can be done in this area. Please send your suggestions and comments to Dr. Royer, at the American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N.Y.

Announced: By Howard Farkas, F.A.I.C., vice president of The U.S. Stoneware Company, the appointment of John B. Scales as technical sales representative of the Chemical Ceramics Division.

We Are Grateful

TO the members of the New England AIC Chapter who were cordial hosts at the Thirty-third Annual Meeting of the AIC in Boston, Mass., May 9-11, 1956.

To the Annual Meeting Committee which consisted of Honorary Chairman, Dr. Warren K. Lewis; General Chairman, John T. Blake; Program Chairmen, John H. Nair and Dr. Austin W. Fisher, Jr.; Arrangements Chairman, Richard S. Robinson; Co-chairmen of the Ladies Committee, Mrs. Austin W. Fisher, Jr. and Mrs. Lawrence W. Bass; the Treasurer, George B. Walker, Jr.; Registration Chairmen, Robert A. Stauffer and John H. Durant; Publicity Chairman, George H. Taft, and the Chairman of the New England AIC Chapter, Dr. Walter R. Smith.

To Arthur D. Little, Inc., Cambridge, Mass., for their hospitality and sponsorship of the reception for the gold medalist.

To Godfrey L. Cabot, Inc., Boston, Mass., for tickets, in connection with the Ladies' Program, to the Boston Pops Concert.

To the speakers and to those who presided over the various luncheons, professional sessions, and the Gold Medal Dinner.

All of these and others made the Thirty-third Annual Meeting of the AIC both highly informative and a most enjoyable occasion.

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Gordon Research Conferences: Of the AAAS, to be held from June 11 to August 31, at Colby Junior College, New London, N. H.; New Hampton School, New Hampton, N. H.; and Kimball Union Academy, Meriden, N. H. Meetings are held mornings and evenings, leaving afternoons free for discussion groups or study. Dr. W. George Parks, F.A.I.C., is director of the Conferences. Mail, from June 10 to September first should be sent to him at Colby Junior College, New London, N. H.

Promoted: George F. Sharrard, F.A.I.C., to director of research and development of R. M. Hollingshead Corporation, Camden, N. J. He was formerly manager of the Technical Service Division.

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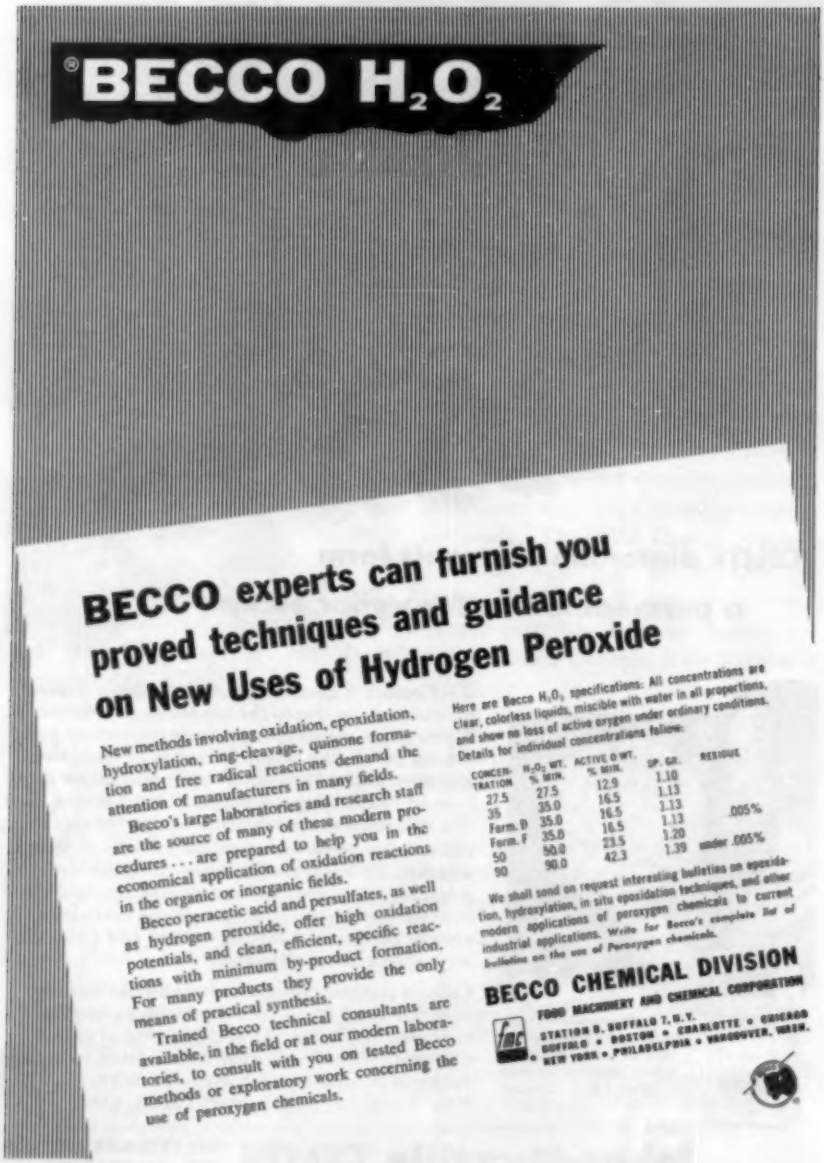
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The Liberating Arts

Raymond Stevens, Hon. AIC

President, Arthur D. Little, Inc., Cambridge 42, Mass.

(Presented when the author received the Gold Medal of THE AMERICAN INSTITUTE OF CHEMISTS, at its Thirty-third Annual Meeting, Boston, Mass. May 10, 1956.)

MODERN science and modern technical developments are so dramatically changing the world that we may well call this era the "Age of the Liberating Arts."

By the liberating arts, I mean applied science carried out in close association with basic science; those activities which Karl Compton once referred to as "the working together of disciplined curiosity and purposeful ingenuity." His words describe well the combination of talents which give unique distinction to this period of history.

The liberating arts are coming of age and may now take their rightful place beside the liberal arts as joint custodians of our heritage of freedom. In some older civilizations, progress towards full realization of the freedom and dignity of the individual has been retarded because respect for the liberal arts has not been accompanied by equal respect for applied science. In newer civilizations evolving outside the Western liberal tradition, we face the alarming prospect of seeing applied science being given strong support without there being an equal respect for human values.

The energetic support of science in Russia, without parallel support of humanistic goals, poses one of the greatest dangers our civilized world has yet faced. In the short run it can only be met by our investing some of our scientific effort in the development of defensive weapons. In the long run, however, the powerful concept of science as the servant of free man will bring defeat to societies built on any more narrow foundation. The future lies with those societies which give strong support to both the liberal and the liberating arts.

The "liberating arts" transform new knowledge into new opportunities for man's growth, and in the doing, enable him to develop his creative powers.

Older civilizations provided gracious living possibly unexcelled by anything we have yet achieved in the modern world. But these were slave and servant cultures. There are those who regret their passing, but rather obviously not the great majority of the human race who would now be slaves or servants but for liberation through the application of science.

Applied science has made freedom a living concept to millions of men and women who in earlier times would have been slaves to man or ignorance or circumstance. We know,

from current experience in many unindustrialized areas, what a mockery it is to talk of freedom to men who are undernourished or even starving, whose lives are circumscribed by the fight for survival.

If we take a poet's abbreviated definition, that "freedom is the right to choose," there can be little doubt that science, even in its most material aspect, has contributed to man's freedom by greatly extending his fields of choice. If there are those who remain skeptical of the progress represented by our having gained the freedom to choose, say, between two-toned cars and those of solid color, so be it. But when it is realized that this same car gives the owner a choice of jobs and journeys unknown to a previous generation, then even the most skeptical must take a second look.

Think of the chain reaction which followed Perkin's discovery of mauve, the Open Sesame to great stores and varieties of synthetics. In the late 19th century, Cross and Bevan announced soluble reconstitutable cellulose. Its fiber was known as artificial silk. Kaiser Wilhelm had brocaded hangings made from it to demonstrate its possibilities. The luxury of silk could be made available in quantity to people formerly denied it. Shortly, artificial leather joined artificial silk; then celluloid brought artificial ivory, then artificial tortoise-shell. Casein gave artificial bristles, and then came an artificial stone.

Eventually, the pride of the chemist and the thrill of the entrepreneur in these "artificial" products led them to reject the overtones of imitation and substitution which clung to their achievements. Artificial silk became rayon, not a substitute, but a new article of commerce. Each new synthetic assumed a name of its own, and so did plastics and chemical products generally. . . .

People resist change, especially those who are quite content with the *status quo*. For the industrialist to become familiar with what to him is abstruse, to visualize applications, to convert to large-scale operation, is not easy. To communicate to him the necessary knowledge, enthusiasm, and confidence; to get him to organize new groups of people and to assemble strange new physical facilities for their work; to carry this all over hurdle after hurdle of skepticism, of active opposition from vested commercial interests, of unanticipated technical difficulties, of consumer apathy — this is an art, the art of the applied scientist in the broadest sense.

The Basic Scientist

And what of the basic scientist? In this discussion of the liberating arts, with its obvious emphasis on the contribution of the applied scientist, I hasten to include and give first credit to the brilliant individual who has the ability to seek out new truths, who is willing to devote his lifetime to the search for new concepts, who demon-

strates, usually early in life, creative ability in science. There are too few of these gifted persons, and they have the same right as the artist, the composer, and the poet to sponsorship and support by society.

Conversely, society has the right to ask that such creative artists and scientists demonstrate some special ability. The mere fact that the work they are doing — the poem, the painting, or the scientific research — has no commercial objective, does not make it creative. Terminology will not make research fundamental. We need more study of how to find, to encourage, and to support, with proper setting and atmosphere, as well as funds, the few creative scientists of our day. We are not helped by indiscriminate support of research and research institutions merely because their work has no commercial or defined objective. We thus dissipate our energy and funds, and distort the approach to the sound plan and strong support for creative new research that we need so badly.

Critical and constructive approaches to the problem of how best to allocate funds for basic research are being made with increasing skill by such groups as the National Science Foundation, the National Research Council, and the Office of Naval Research. But the ratio of mediocre research and accomplishment to the man-hours and dollars spent is still too high. We have much to learn.

Fundamental, pure, Corinthian science, the search for new truth wherever it may be found, the visualization of concepts new to the human race, deserve unstinted support. This creative activity requires unusual ability and with the ever-increasing accumulation of knowledge, it requires increasingly long and arduous preparation. It requires a devotion to a single purpose almost incomprehensible to those who have not been closely exposed to its devotees. It requires freedom from distraction, and only the high priests of the order can continue their mediations and their searches in the noisy, active atmosphere of industry, or the time-demanding, intellectually distracting atmosphere of the undermanned college.

There are those who claim that Europe has an exclusive franchise on an atmosphere conducive to fundamental research. The imposing list of discoveries and the statistical record of Nobel awards are cited in proof of the argument. Others believe that time has been a factor, that research is younger in non-European nations, and that the differential will disappear or perhaps even be reversed in the future.

But no one is quite sure how to grow and nourish Einsteins or Pasteurs, or what system of education, selection, and support will give them best opportunity.

We do know, however, that the application of the truths fundamental scientists discover does not interfere with the discovery of still other truths.

That applied science is in any way the enemy of fundamental science, or is incompatible with it, or, to reach the absurdity sometimes implied, consumes our store of fundamental knowledge, seems a fallacy that should be contradicted and confuted at every opportunity. Applied science has fed support back to fundamental research to such an extent as almost to have earned it the title of Patron of the Art.

Communication Essential

A big danger lies in any tendency to widen the gap between any group of scientists, any tendency to think of one type of scientific activity as competing with, rather than complementing, another. Instead, we must do all in our power to increase communication and understanding, not only between all branches of science, and between scientists and engineers, but also between technical personnel and their nonscientific colleagues in education or industry, and between centers of science and the nonscientific world. We have only begun to open the door to the opportunities which will be presented as the full partnership of scientist and nonscientist becomes a reality . . .

On anniversaries and other special occasions when scientists gather together, it has become quite customary to recite lists of accomplishments of scientists, "pure" and "applied." We have reached the point where discussion of the addition of a new satellite to the earth or of reflected messages from the moon share headlines with the current robbery or the announcement of a new hat in the political ring. Statements of what we do not know, or cannot do, have been conspicuous by their absence, as have clear definitions of any of the many other challenges we face.

We Need More Gracious Living

One great challenge is this: Can we establish truly gracious living without slavery and without the barren drudgery of so much of the servant life of the past? We have not yet begun to take full advantage of the opportunities for more gracious living which our scientific advance makes possible. We may boast that the general public today can have evenings of chamber music in the home with as much ease as could Frederick the Great. We may be proud that the art of the Great Masters can now be enjoyed by millions of persons, where before it could bring pleasure only to the wealthy few. We can delight in the increase in leisure which the growing productivity of industry has made possible. But we have not yet learned to live with ourselves in the new setting. We are all *nouveau riche*.

The liberating arts must participate in meeting this challenge. We supply a multitude of automobiles and too many jet planes, and the noise that goes with them. The earliest electric refrigerating machines were so noisy that some housekeepers preferred the once-a-day clomp and mud of the ice-

man's shoes to the continuous roar of the new gadget. . . . Slowly the noise level of refrigerators has been reduced until now it can be drowned out by the new Disposal. Our present life is noisy beyond all desirability, and the liberating arts must continue to work at solving the problem by other means than ear plugs.

Our present mode of life takes too much time of too many people for transportation that is neither healthful exercise nor conducive to meditation. Suburbia gives far too much of its free and otherwise controllable time to going to and from its various activities. The answer is not more speed, and to find the right answer will require the cooperation of many types of mind. We cannot accept the present mode as civilized.

We must find ways of increasing the amount of beauty and serenity in our lives. We must nourish the growth of a society in which there is much greater opportunity than we now have to think long thoughts, to feel what it means to be alive (in contrast to being busy), and to enjoy the good fellowship of family and friends.

We need more gracious living. We also need more thoughtful living. I think of the problems we face as modern medicine reduces the death rates in overcrowded countries with high birth rates. I think of the problem presented when we improve physical communications and thereby facilitate the work of the demagogue as well as the saint. I think of the problems which arise as improved transportation makes close neighbors of peoples of widely differing idealogies and stages of development. If tragedy is to be averted, we must act with urgency to reduce the great contrasts in poverty and wealth between the "have" and the "have not" nations.

These and other problems have been created by the application of science, and they are not to be belittled. But he is a craven individual indeed who will not accept the responsibility that goes with freedom. We must accept the challenge, for no one now dreams of a "moratorium on applied science" such as was once seriously proposed.

To meet the challenge, we need better understanding and closer cooperation between the workers in the field of the liberating arts, and the workers, thinkers, and leaders in the other arts and in religion. Barriers between the sciences and humanities still exist, despite the impressive strides we have taken towards overcoming them. We must eliminate these barriers if we are to move towards challenging goals at a rate consistent with the present state of our knowledge.

The Human-Relations Factor

We need to face with candor the fact that there are still too many scientists and engineers who are reluctant to accept the human dimensions of their jobs. In the past, perhaps, the fields of science and engineering could provide a haven for persons who pre-

ferred to deal with "things" rather than people. This is no longer true.

With the explosive expansion of most fields of science, the need for close communication among scientists becomes imperative. The percentage of scientific work which must today be carried forward by groups of scientists and engineers from a variety of fields is increasing. At the same time, even to keep up with what is happening in his own field, the scientist must meet with other scientists to exchange findings and views. He can no longer depend entirely on reading published literature or on correspondence. He must learn to judge the human element when he evaluates new work. He must learn to accept the fact that to a large extent his own success will be determined by his ability to work closely with others.

In the field of applied science, the human relations aspect becomes all-important. Hardly a move can be made which does not involve satisfactory dealing with another scientist, an engineer, a businessman or industrialist, or even a salesman. Applied science is an art, a highly developed art, and one in which the human touch must be predominant.

Leaders in scientific and engineering education have recognized the need of a broader — a more liberal education for scientists and engineers. There are those of us who would match the best of our engineering schools against the best in our arts schools on the sole criterion of preparation for a full life. But in all education we run the risk of being trapped into complacency by a confusion of terms. Mere study of the "humanities" does not necessarily endow a man with more humanity, nor can it alone prepare him for success in working with other people.

Literature, music, history, and many other liberal arts subjects can be taught as "disciplines" without enhancing the ability of the student to deal successfully with his fellow men. Even the critical study of Greek philosophy can be sterile unless the student uses this knowledge to increase his understanding of the lad at the next desk. Knowledge of the development of Roman Law is of small value to the scholar who sees in it no relevance to the pressing problem still current today, of how men can learn to work together in amity and peace.

Study of the classics is not in itself a discipline in the art of living or the art of dealing with people. Yet these are the arts that the applied scientist needs, as do all men and women who would lead effective lives. Quite possibly these arts cannot be taught, but we can at least make sure that no engineer or scientist is graduated from our schools who will later be able to say: "They did not tell me in college that an engineer has to deal with people."

We must be equally sure that no student in the liberal arts colleges will

be graduated without having obtained a good general understanding of our present stage of scientific knowledge and an appreciation of the contribution of applied science to our daily lives. The liberal arts and the liberating arts are two aspects of a single culture. No man or woman can be considered well educated who does not have some understanding of both.

Since the liberating arts are the younger arts, we need to take a special interest in nourishing their growth. We must give support in every possible way to the creative individual — from his earliest years in school through his adult working life. We need to do much more than we have in the past to discover and encourage the child with potential scientific ability. We need to give more honor to the scientists and technologists, though they themselves would be the last to demand it.

Most of all, we need to create and maintain an atmosphere in which the liberating arts can flourish. It is a matter of keeping our society fluid, our minds open to change, our spirits in tune with the adventurous progress of science. We must have the vigor to see each new problem as a new challenge to the wisdom and ingenuity of man. We must have the courage to keep moving ahead with faith that our problems can be solved.

Introduction of Raymond Stevens

Dr. Lawrence W. Bass, F.A.I.C.

Vice President, Arthur D. Little, Inc., Cambridge 42, Mass.

(Presented at the Gold Medal Banquet, May 10, 1956, at the Thirty-third Annual Meeting of The American Institute of Chemists, Boston, Mass.)

I HAVE known Ray Stevens for nearly thirty years as a friend, as a colleague in scientific society affairs, as a client of his firm, occasionally as a competitor, and more recently as a business associate. . . .

One of my early close associations with him was in the survey of American industrial research which he carried out just before World War II for the National Research Council under the auspices of the National Resources Planning Board. He delighted the committee with his astute planning of the project, his ability to get very busy people to work with him and the drive and enthusiasm with which he carried the program forward. The result — an impressive volume called, "Research — A National Resource" which speaks for itself. It is still, after fifteen years, a classic in this field.

"Drive and enthusiasm" come at once to mind when one thinks of Ray Stevens. I recall how he grasped the importance of Operations Research as a tool for management at a time when,

Lawrence H. Flett, Chairman of the Medal Award Committee; Dr. Ray P. Dinsmore, Retiring AIC President, and Raymond Stevens, Gold Medal Recipient.

although its utility had been shown for military operations, it had not yet been applied to industrial problems. I remember a talk Ray gave to a group of research executives several years ago when this new research technique was still in its infancy. He presented a convincing argument that, while its immediate applications were not apparent, it was a type of analysis which we needed to watch. His vision has since been proved. Operations Research has flowered into an important activity, and one in which ADL has been a pioneer, largely as a result of Ray's intuition.

It was this same intuitive understanding of the future importance of an expanding activity that led Ray to enter the business of industrial research shortly after his graduation from Massachusetts Institute of Technology in 1917. Following service as a lieutenant in the newly established Chemical Warfare Service, he joined ADL in 1920 as an assistant to the late Arthur Dehon Little. Ten years later he became a vice president, and, in March of this year, the third president of the company.

During the thirty-six years of his association with Arthur D. Little, Inc., Ray's inspiring vision has been a vital factor in the company's dynamic contribution to the development of industrial research in this

country. At various periods he played an active role in recruiting personnel for the exploration and application of such new fields of applied science as marketing research, low temperature research, operations research, computation, and automation. He has given encouragement and support to young scientists and engineers at all times. He recently devised what has become known as the "Lexington Plan," a plan through which our company is aiding three nearby high schools in recruiting science teachers by giving recent college graduates an opportunity to alternate teaching with work in our laboratories.

His success as a guiding force in our company's development reflects his astute business foresight regarding the needs of industrial management for outside professional services. He has a gift for sensing such needs before industrial executives find out for themselves the gaps in their internal technical programs.

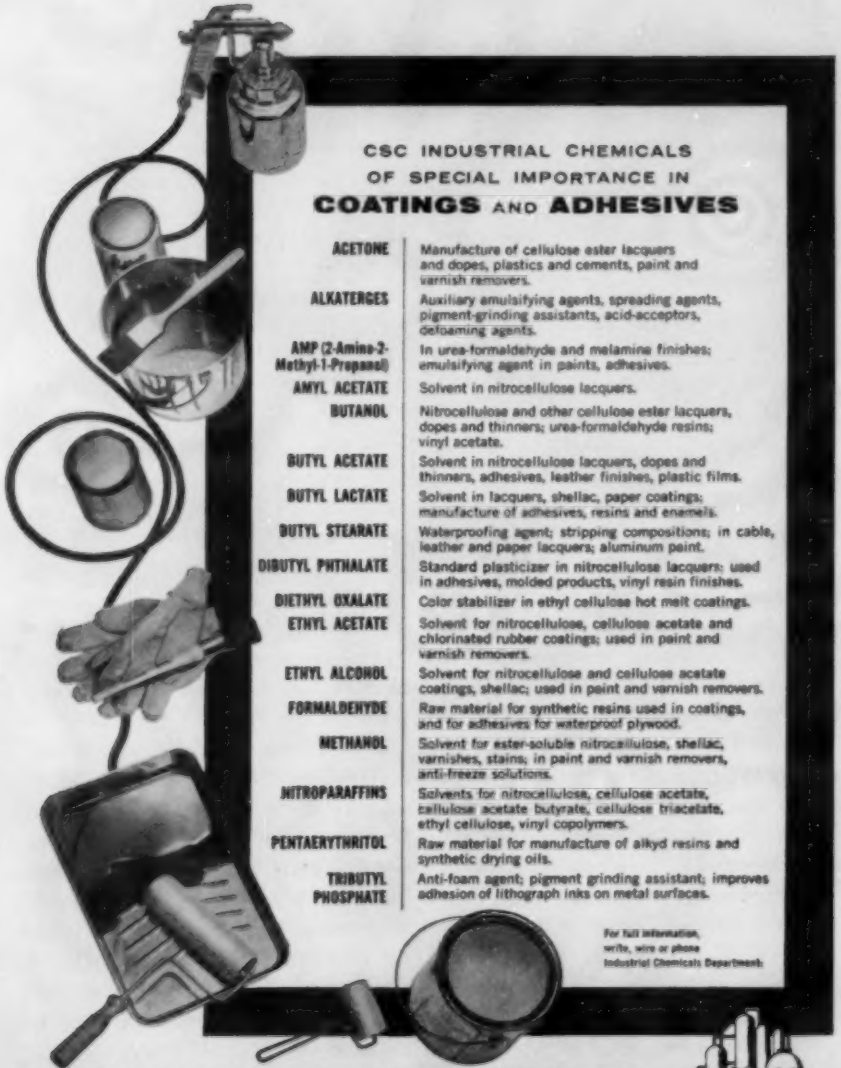
Convinced as he is of the need for management to keep closely in touch with advances in science, Ray has taken a keen interest in ADL's *Industrial Bulletin* since its founding in the mid-twenties, and for many years served as its editor.

Despite his devotion to ADL's expanding activities over the years, he has always found time for public and professional service. During World War II he was chairman of the Committee on War Use of Research Facilities, and in 1955 he became chairman of the Advisory Board on Quartermaster Research and Development. He has been chairman of the Northeastern Section of the American Chemical Society, and is the retiring honorary chairman of the American Section of the Society of Chemical Industry. He has been an intensely loyal alumnus of MIT, has served his alma mater in many capacities, and held the high honor of president of the MIT Alumni Association in 1944-45. He is president of the Woods Hole Oceanographic Institute.

The picture is not complete without including his family. He thoroughly enjoys his family and there is no doubt about their enjoyment of him. His son Frank is with Raytheon. David teaches English at Williston Academy. They have given good companionship to Ray, as have their wives and children.

I have been saving the most important part of his life, his marriage to the girl he grew up with in Nashua, New Hampshire, for its rightful place, the climax. Katherine Stevens is a very special person to all who know her, and particularly to the man who knows her best. Ray is the first to give her credit for contributing in overflowing measure to the career that has led to our honoring him.

To refer to the keynote of this convention, Ray is a superb communicator, too! I am proud to present: Raymond Stevens, president of Arthur D. Little, Inc., our guest of honor.



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Communication Between Professional-Technical Men and Industry

C. B. Delano

Director of Personnel, Thomas J. Lipton, Inc., Hoboken, N. J.

(A condensation of a paper presented at the First Professional Session, "Communications in a Technical World," at the 33rd AIC Annual Meeting, Boston, Mass., May 10, 1956.

WHETHER a professional-technical man is engaged in primary research, new product and process development, or improvement and control in existing processes, it is obvious that someone believes that the benefits, are or will be economically justifiable to society. Technical men form a chain; the pure scientists in the university laboratory discover basic principles; the development scientists work out practical applications from these basic laws, and finally, another group handles the transition into mass production, with its problems of cost and quality maintenance.

At this point the marvelous brain work is transformed into socially worthy and needed products and services which are economically justifiable. In this transition from the "ivory tower" to the welcoming hands of the "common man," industry is the catalyst. Great as are the scientific achievements of the past and those to come, the whole process would grind down to an unpredictable minimum were it not for the functions which industry performs.

Now industry provides the salaries, equipment, and materials with which scientists work. This money has come through sales of products and services, the ideas for which previously came from the broad field of scientists. Thus, industry must look in two complementary directions in accomplishing its function—to the consumer and to the professional-technical group.

Industry's main communication interest between itself and the scientists concerns receiving from them advice about those things which are possible and relating back information about those things which are wanted. Therefore, it evolves into a situation where scientists propose a large number of things possible, not knowing, in most cases, those things which are wanted; and industry asks for many things wanted, not knowing what is possible. Therein lies the importance and heart of the problems of communication.

If it seems that the scientist's problem of applying his talents most usefully presents a difficulty, it would be well to consider the geometrically compounded problem of industry relative to the scientist's problem. Industry is not only unaware of what the scientist may be able to produce, but also uncertain as to what the con-

sumers want.

Thus, the work of industry is to know what is wanted and what scientists may be able to discover, invent, or apply, which is economically justifiable. Industry can thus do a better job with better knowledge of the scientists' ability and requirements. Scientists, too, can do a better job with a better knowledge of the economically justifiable wants for the products and processes which industry desires.

The common factor to the two groups is better knowledge of the other's prime reason for being. This knowledge to be effective must be transferred from one group to another, which is, in essence, the meaning of "communication."

The burden of transference of knowledge from the pure scientist to the development and producing professional-technical men, must, of its nature, remain primarily the responsibility of the scientists and not of industry.

Here I refer exclusively to technical knowledge. It might be well to go into the two general aspects of relationships and communication. One involves the scientific technical knowledge communication and the other involves the human relations between the various scientists and business people with whom they work. These are inter-locking divisions, one cannot exist without the other and they often overlap.

In relative importance they are inseparable. However, all scientists were human beings with the attendant human relations problems before they received their technical knowledge and standing. This fact means that there can be no escape from human relations effects. These human relations effects can so drastically alter the creative and analytical technical mind as to inspire or obliterate creative scientific thought, and thus, the relationship between management of industry and the scientific man involves not only the technical communication but human relations communication also.

(*Turn to page* 212)

CHEMISTS COMMUNICATING

On the opposite page, from left to right starting at the top, are the following speakers at the 33rd AIC Annual Meeting: Dr. Austin W. Fisher, Jr., of Arthur D. Little, Inc., who presided over the first professional session on "The What and Why of Communication;" Dr. Robert Freed Bales, Laboratory of Social Relations, Harvard University, who spoke on. "The Psychology of Human Communication;" C. B. Delano on "The Importance of Communications to Industry;" Robert Cowen, Natural Science Editor, *The Christian Science Monitor*, on "The Why and How in Interpreting Science for the General Public;" Dr. D. B. Keyes, who asked the questions about secondary school education — Dr. Fisher is behind the microphone recording the answers. The sixth speaker is the new AIC president, John H. Nair, who presided over the second professional session on "Communication and the Scientific Professions." Next is Dr. Walter J. Murphy, who spoke on "Communication Within the Professional Society." The final picture is that of Dr. Dwight E. Gray, who discussed "Interdisciplinary Communication Among Scientists."

Individuals vary and generalizations must be taken with great care. However, as scientists, some thought should be given to the fact that in general the intelligence required of the scientist almost requires a special degree of quiet and single-minded thinking. The best technical minds must work primarily within themselves in contrast with those activities which involve personal behavior and those people whose activities involve, primarily, human contacts.

Scientists should make a special observation of themselves to see that (not only for their personal economic advancement but for the achievement of due credit and acknowledgment of their scientific and technical work) they are not "hiding their candle under a bushel" through their innate nature. Some scientists may be associated with industry which is aware of this natural modesty of the scientific mind and, thus, in fairness, puts forth special effort to seek out the deserving scientist with appropriate acknowledgment of his scientific work and with commensurate remuneration. This admirable breed of industry, unfortunately for scientists, may be few in number. So in self defense, it behooves the scientist to stop occasionally and check to see if he is "blowing his own horn" enough.

The days of Pasteur, Steinmetz, and Edison are gone for the most of scientific progress. Along with the increase in size of industrial enterprises, has gone the increase in size of technical and scientific organizations. Thus, while the body of scientists look at industry primarily as the management segment, there has also developed a management section of scientists in the field of science. These scientist-managers become the liaison force for both the technical and human relations phases with industry management. This poses a tremendous job of communications. They must oftentimes not only be capable scientific and technical leaders but skilled and wise human relations administrators. Concurrent with the recent tremendous advances in science, has been the influence and importance of these scientist administrators in the general affairs of industry.

Today, the research head sits with the financial, production, and marketing experts in the high councils of American industrial management. The quickening pace of scientific accomplishment has made the success of not only companies, but whole industries, more dependent on the accomplishments and acceptance of advice of the scientific and technical parts of business. It has reached the point where industrial management cannot question whether it should have satisfactory communication with the professional-technical men for the old reason that it is generally recognized as a good thing. Not so—because the degree of success and even continuation of individual industries are more and

more dependent on satisfactory and prompt communication between the two.

Information about the scientific group may come directly from management or by means of committee in which sales, advertising, production-processing, transportation, procurement, and financial departments are represented. The origin of requests for new products frequently is the sales or market research group.

Nevertheless, there are probably more requests for changes and alterations in existing products or processes than suggestions for new products. All of the other departments for various reasons may propose activities which require the assistance of the research and scientific part of the business. For instance, difficulty in obtaining a raw material may result in the procurement department suggesting that a substitute be developed. Difficulties in storage or transportation of existing products may prompt traffic or transportation sections of the business to seek alterations in the products.

Changes requested by the production-processing end of the business are likely numerous because of difficulty in manufacturing, either from a maintenance of quality standards viewpoint, or from working conditions induced by current products and methods.

The advertising department may wish alterations in order to overcome current difficulties or to permit emphasis on new and desirable changes which will assist in the sale of the product.

Some businesses are much dependent on continuous creation of new products or drastic improvement in the old. In such businesses, usually the research or scientific and technical director is more immediately associated with the president or executive vice president of the company. In those companies where the products are more stabilized, it is more likely that the scientific and research group may be under the direction of the chief manufacturing executive.

So far, the system of communication has assumed that the heads of departments are involved in the interchange. However, a great deal of useful interchange is accomplished at all levels. Perhaps the bulk of the transfer of information occurs between members of the various departments cooperating in an efficient manner, with the department heads receiving only the results. A good practical working relationship between members of various departments at all levels is a great aid to the efficient handling of company business. With proper communication and cooperation, at various levels in all departments, great things can be accomplished . . .

In most companies, the research department is a staff department, which, however, is organized on a line basis. The director, in a staff capacity, is the

main liaison officer for his group, both to management and in committee, to other major departments. However, as top man in his own line organization, he has all the problems of a line administrator.

The ever-increasing size of scientific groups has required a greater number of levels of authority to handle the work. The increase in the levels of authority has brought about a decrease in personal contact between most of the staff and the director. This has some disadvantages for the individual scientist because of the administrative levels through which his ideas must go before they receive a decision from the final authority, the director. However, this system seems to be the most practical way for making the greatest use of the total abilities of the group.

The fact that ideas are exposed to a greater number of trained minds increases the opportunity of usefulness, as variations or tangential applications may suggest themselves to others. The importance of teamwork and cooperation between scientists thus can never be over estimated. The body of knowledge handed to us from the past, built up grain by grain through the years, forms the foundation from which every advance has been built. Even those parts where contradiction incited a doubt and thereby spawned the finding of ultimate truth have served their purpose.

Many times the financial aspect causes the director of scientific groups to reject ideas which may be admirable and exciting from a technical standpoint. This is not easy for him to do, knowing that the genius of creative ability should be nurtured along its natural lines. However, in industry it is necessary that financial considerations have their proper weight. For financial reasons only the very large companies can usually afford to do basic research. Though there is a trend toward more basic research by private industry, the greater part remains in the sphere of the university. Many larger companies which feel they can not afford their own basic research groups allot funds to subsidize projects by university groups. There is also a growing trend of grants to universities and provision for more scholarships. Business thus indicates its understanding of the growing importance of scientific development. When industry takes dollars out of its pocket, it thinks it is getting or will get its money's worth.

Warnings are sounded about our shortage of new scientists as compared with Russia, where nearly 700,000 scientists, engineers, technicians, and science teachers have been produced since 1928. The United States has produced only 500,000, so that Russia has trained 40 per cent more scientists than we have. By numbers this speaks dramatically, but it does not consider the quality of the scientific minds nor the motivation factor.

Though the lone scientist who produces the spectacular developments is not typical of scientific achievement in

the modern age, the individual mind is still the basic unit of thinking.

Were it not for communication between scientists, our more productive overall system of group effort would not operate. Thus the degree of scientific effectiveness of a number of scientists may closely approximate the degree of the effectiveness of the communication between scientists. The same principle applies to communication between scientists and industry for the application of scientific findings. There is, therefore, a challenge to the entire body of scientists to communicate between themselves and with industry. The proposition here is that mere numbers do not create the problem nor necessarily answer it. By superior interchange of knowledge, the usefulness of individual technical achievements can be expanded and in turn the motivation for further individual efforts can be stimulated.

In spite of the amazing increases in funds spent by private industry for scientific purposes in the past fifteen years, the present rate is only a small stream compared to the mighty river it may become.

This, in great measure, depends on you. If you continue to discover, invent, help create, you will find the flow of funds for your purposes continually enlarged. Your best efforts to bring this about, for your own financial betterment and satisfaction in accomplishment, and for the strengthening of our western way of life and the improvement of society the world over, may be expressed in several ways:

> Try for better communication between your fellow scientists for the widest usefulness of your experience.
>
> Think in terms of the real accomplishment which teamwork has brought as contrasted with the fractional value an idea may have if held too close for fear greater personal credit will be missed.
>
> Make greater efforts to understand the reasons why financial considerations must often influence the direction of your activities.
>
> Strive to make your scientific endeavors understandable to management in such a way as to achieve a fair and practical evaluation of its worth.

All of these things require better communication between professional-technical men and industry. The management of industry is striving for this because they know its worth. Whatever you may be able to do to help in improving this two-way communication street will make for better and more satisfactory answers to you from industry.

Your scientific achievements of the future will be more amazing than those of the past. Let us exploit these accomplishments by adequate communication. Pursuing this, I cannot imagine a more rewarding life intellectually, socially, and economically for any group than that which professional-technical men have now before them.

Elected: Dr. Emil G. Klarmann, F.A.I.C. of Lehn & Fink Products Corp., as president of the Chemical Specialties Manufacturers Association.

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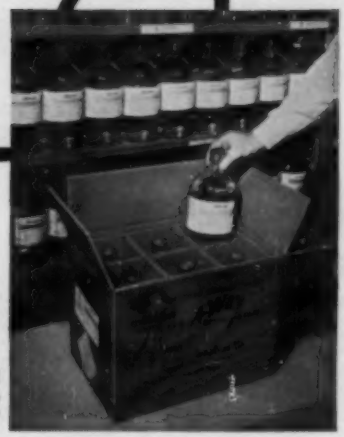

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The Results of Questions Asked About Secondary School Education

Dr. D. B. Keyes, F.A.I.C.
AIC Councilor and former AIC President
420 Lexington Ave., New York 17, N. Y.

(The questions were asked at the First Professional Session, "The What and Why of Communications," at the 33rd AIC Annual Meeting, Boston, Mass., May 10, 1956.)

AS requested, I am briefly summarizing the results obtained, with the help of Dr. A. W. Fisher, Jr., from the "yes" or "no" replies to certain pertinent questions on secondary school education problems existing today. It was hoped that we might obtain by this operation the basic thoughts on these problems of this relatively small group (about seventy) of highly intelligent people.

The reader should remember that this group which indicated the preferences was composed largely of mature chemists and chemical engineers; no students were present.

Many of those present were nationally and internationally respected in the chemical world. Most of those present were thoroughly familiar with this national problem long prior to this meeting.

Contrary to the attitude of the public which is asked questions for national polls, this group showed very little indication that it wished to please either the questioner or the other members of the audience.

With these facts in mind, we believe these results indicate the honest opinion of this particular audience *only*, and *not* necessarily the opinion of the AIC, scientists, engineers, educators, politicians, or the public.

Questions and Results

1. How many of you people are parents?

About 65 of the 70 raised their hands. Incidentally, this eliminated for the moment an Honorary member of the AIC, of international fame, much to his annoyance.

2. How many of you parents believe every little "moron" (Your neighbor's child) should be educated from kindergarten through college, at the taxpayers' expense?

Only two courageous individuals raised their hands. If the audience had consisted of educators or politicians, we assume the results would have been quite different.

3. How many believe that in large cities there should be at least one technical high school with rigid entrance requirements?

About 35 agreed with this idea. Other technical groups have felt this is a practical suggestion, but,

of course, only feasible in large communities.

4. Recognizing that school teachers, at least the competent ones, are underpaid, would you agree to make raises in your community entirely on the basis of years of service and not on the basis of merit?

Only one person agreed. It is interesting to note that though our school teachers, years ago, were advanced on the merit basis, it is no longer true in most cities and states. We are told by educators that *all* teachers must be kept "happy" because of the critical shortage of teachers. It is obvious that one of the primary causes of this shortage is the recent enormous demand for teachers. This demand for high school teachers in turn seems to be caused primarily by the philosophy (socialistic, but not Russian) that *every* child *regardless* of mental ability *must* graduate from high school and *with no delays along the way.*

One distinguished scientist proposed that each and every child on entering kindergarten should be presented with a high school diploma. This is an excellent example of a truly creative thought.

5. Knowing the need for scientists and engineers, would you be willing to pay more for science and mathematics teachers than you do for your English and history teachers, but still not as much as you pay your basketball or football coach?

Only three agreed to this, indicating that most of the audience had thought about this matter before. We have been told repeatedly by prominent educators that no such differentiation is desirable or possible today.

6. How many of you people know your high school math and science teachers?

Thirty-three persons raised their hands, approximately half. This gave us a new base.

7. How many met the teacher because your hopeful had difficulties?

Only three admitted it. We feel that we should have revised this question because the grand old law of probabilities indicates that most parents are loyal to their children, especially in public.

8. How many of you parents have done and are doing right now something to really help your local schools?

Thirteen, or about twenty per cent, indicated they were. There seems to be an increased interest on the part of scientists and engineers in their local school problems. We attribute this to the excellent review of what Russia has done and is doing to educate scientists and engineers and the intensive propaganda of a few persistant souls who saw this national problem long ago.

9. How many do nothing except to crab about the "deplorable situation?"

Four honest men raised their hands.

10. How many believe you have a competent man at the head of your local schools?

Twenty-one, about thirty per cent, raised their hands. Experience has shown that this is an important factor.

11. Of those who do not feel that they have a competent man at the head of their local school system, how many feel discouraged, or frustrated, and are just sitting on their hands?

Again, three honest men raised their hands.

12. How many present work for industry?

About fifty raised their hands. This was to obtain a new base.

13. How many of you people work for companies who are actually doing something for secondary schools?

Sixteen, about thirty per cent, so indicated. We have noticed a marked increase in interest on the part of industry during the past year. We attribute this to the newspaper publicity on the Russian educational policies.

14. How many are actually working in your company's program in this field?

Ten persons so indicated. It must be remembered that such company programs require a public spirited "crusader" and often he is neither a scientist nor an engineer.

15. How many of you people work for companies who support scientific research in colleges?

Twenty-three, about 50 per cent, raised their hands. Today most large companies appreciate the value of properly placed fundamental scientific research in our colleges and universities.

16. How many of these companies support scholarships for under-graduates?

Fifteen, about 60 per cent, was the answer. There is a growing tendency to support the undergraduate as well as the graduate student, by companies large enough to afford such a program.

17. How many in the audience feel the Federal Government should financially help States and local communities where additional educational facilities, such as buildings and equipment, are badly needed, and the state and local taxpayer is unable to provide adequate sums?

After considerable discussion the question was narrowed at a "proven need" and for this purpose (facilities) only. The response in favor was about 50, or 70 per cent, of those present. It should be noted that this is a modification of the idea expressed by President Eisenhower some time ago.

18. How many taxpayers present would be willing to pay more if it could be demonstrated that the addi-

tional taxes would be used solely to improve your local schools and the improvement would be "guaranteed" by a competent and honest government?

Essentially all those present indicated that they would. It is interesting to note that the majority of taxpayers in New York State who voted last year voted against a proposed bond issue for much needed new roads presumably because Albany refused to "guarantee" that the funds would be used exclusively for this purpose. Our admiration for the public has increased. It is quite possible that the public might react favorably toward a tax increase for this educational purpose if they were convinced that the funds would be effectively spent.

19. How many would be willing to help create in your local community a non-political, non-profit organization of citizens to bring about better schools?

Twenty-two, or thirty per cent, indicated that they would. We have learned that several informal organizations of this type are already hard at work. We wish them all success.

20. How many would prefer to just sit and gripe?

Two honest and independent souls indicated that they would.

Conclusions

After a careful study of these results, Dr. Fisher and I have come to only one conclusion. We believe that it was far easier for us to operate this question period than if either one of us had attempted to give a talk on the subject, "Reaching the Future Scientist."

We have no means of knowing whether or not the audience enjoyed this performance. We did not care as it was planned for our education and our amusement. *We* certainly had a good time!

Changed: The name of the Santa Fe Operations Office of the Atomic Energy Commission to the Albuquerque Operations Office. It has been administered from Albuquerque, New Mexico, since 1951.

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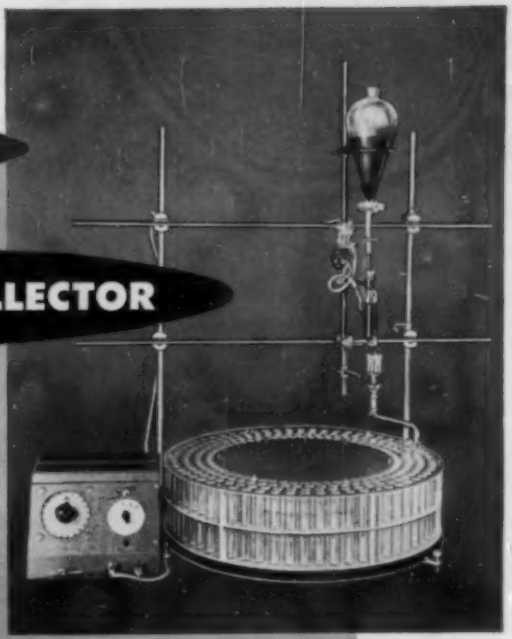

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Communications Within the Professional Society

Dr. Walter J. Murphy, Hon. AIC
Editorial Director, American Chemical Society, 1155 16*th St., N.W., Washington* 6, *D.C.*

(Condensation of a talk presented at the Second Professional Session, "Communication and the Scientific Professions," at the 33rd Annual AIC Meeting, May 11, 1956, Boston, Mass.)

ONE would expect special problems in regard to communication within a professional society. What is a professional society? It is an organization built on voluntary membership. This is true at least in the fields of physical sciences . . .

The problem of communication within a small society is not as difficult as it is in a large organization such as the American Chemical Society, with its 78,000 members residing in every State and in many foreign countries. We have twenty-one divisions, some of which have subdivisions. We are concerned with approximately 150 local sections ranging from units of 25 up to 6000. In some of the larger sections there is a duplication of our national divisional setup at the local section level, because the occupational interests of the membership vary.

Under the umbrella of the Society we have those engaged in pure or fundamental research, in teaching, in industrial research, in equipment design, in production, in management, in market research, technical service, transportation, sales, advertising, and many more classifications. We have rubber chemists, petroleum chemists, coatings chemists; chemical engineers who are specialists in plant or equipment design, in the operation of plants that vary from the field of textiles to nuclear power reactors. We are dealing with very heterogeneous segments.

What is the common denominator that brings these 78,000 men and women under the "big tent"? All are trained as chemists or chemical engineers; all realize they belong to an outstanding profession and there must be one organization that meets most of their needs.

This indicates the magnitude of the problem of maintaining proper communication. Without adequate lines of communication the various segments would tend to fragment and scatter in all directions. . . . We have a precious heritage. One way of guarding it and adding to its stature is through proper and adequate communication. I doubt that any professional society provides more channels of communication than does the ACS. Does this mean that every member is fully or even reasonably acquainted with what has tran-

spired, what is going on, and what is planned for the future? They are not anywhere near as well informed as they should be. Our lines of communication can be improved.

"You can lead a horse to the trough, but you cannot make him drink." A professional society can provide reasonably adequate avenues of communication, but no one can compel a member to read a 56-page annual report. There are some "gimmicks" that may entice a society member to read about his society. We in administrative posts are endeavoring to adopt these as fast as possible. Today we hear a great deal about visual presentation, attractive layout, digests or summaries of long reports, etc. These have a place and an effect. How much is hard to determine quantitatively.

The responsibility of providing communication within the Society, at least at the national level, is shared by the executive secretary, the editorial director of the applied journals, and the director of the ACS News Service. I occupy the latter two positions.

The executive secretary is primarily interested in the communication problem as it affects members; while the editorial director of *Chemical & Engineering News*, and the director of the News Service are primarily concerned with publicity and public relations. This general statement is, however, misleading, because it is also the executive secretary's responsibility to deal with other organizations and work on problems of public interest. Similarly I am responsible for a wide area of communications directed to members and dealing with membership matters. Close cooperation and coordination happily exist.

Let us examine specific examples of communication within the Society: When a member is accepted, he receives an 84-page booklet from the executive secretary's office, entitled "It's Your Society." In this the new member is indoctrinated into the objectives of the Society, the types of membership, the program, the publishing operations which represent 83 per cent of a total budget of approximately $5.5 million; the role of local sections, divisions, meetings; the pub-

(*Turn to page* 226)

CHEMISTS COMMUNICATING

On the opposite page, from left to right, starting at the top, are the following speakers at the 33rd AIC Annual Meeting: Dr. W. A. Noyes, Head, Department of Chemistry, University of Rochester, speaking on "International Scientific Communication;" Francis J. Curtis, vice president, Monsanto Chemical Company on "Communication Between Older and Younger Professionals;" Richard L. Moore of Foster D. Snell, Inc., New York, N. Y., who presided over the Third Professional Session on "Communication and the Individual Professional Man;" Dr. C. C. Price speaking on "Communication and Participation in the Community;" Dr. Johan Bjorksten, on "The Tools of Communication;" Dr. Sidney D. Kirkpatrick, on "Communication as a Factor in Success or Failure on the Job;" Dr. Ray P. Dinsmore, retiring AIC president, who spoke at the Institute Luncheon; and Dr. John T. Blake of Simplex Wire and Cable Company, Cambridge, Mass., who presided at the Keynote Luncheon.

lic relations program and activities; list of awards, and information about local sections; section publications; officers and addresses.

Included in the list of the many booklets issued by the executive secretary's office are: Handbook for Local Section Membership Committees, Manual for Student Affiliate Chapters, the Constitution, Bylaws and Regulations, Information for Local Section Officers, Local Section Activities; Awards of the Society, and "Hints to Authors" a booklet instructing those who present papers at ACS meetings.

The Board of Directors meets four times a year. The agenda for these meetings usually constitute a good-sized book. Agenda for the two Council Meetings are prepared in the executive secretary's office, as is agenda for the Council Policy Committee and for the Board Committee on Publications.

In addition the executive secretary is in constant communication with the Board of Directors, committees of the board, council committees and members, local section officers, and outside organizations. He has a tremendous volume of correspondence with members, editors, standing committees, etc. Details in connection with national meetings are cleared through his office. Ronald M. Warren, one of Alden Emery's assistant secretaries, is busy the year round handling the multitudinous details connected with national, regional, subdivisional meetings, and symposia.

We communicate because it is a basic thesis that the more the membership understands what is going on, what is expected of them, and where they can contribute, the more the organization will come closer to fulfilling its objectives.

Each year we publish in C&EN the annual report. In 1956 it consisted of 35 pages and cost about $7,000 to produce, which represents the bare mechanical and distribution costs. Following every national meeting, we publish in C&EN the highlights of the Council meeting. We publish the executive secretary's report of council activities twice a year. Four times a year we publish a report of the four meetings of the Board of Directors. In 1955, we published 222 pages of formal ACS reports out of a total of 2,600 editorial pages. They required over $40,000 to produce. A few years ago, I estimated that about 20 per cent of the editorial pages in C&EN had a direct bearing on society matters . . . in 1955 the total pages devoted to ACS matters were about 526, an average of 10 for every issue. It may be appropriate to ask, are we furnishing too much or too little?

In C&EN we cover special meetings of local sections, special divisional symposia, changes in members' positions; programs of regional meetings, meetings-in-minature and much other information about Society activities...

We have preached the gospel that the most effective way of achieving good public relations was to stimulate our local sections to carry on such activities at the grass-roots level. This is not easy, because most chemists and chemical engineers have had no training in public relations work, and only a small percentage of the total membership are willing to put their shoulders to the wheel.

The ACS News Service consists of eight or nine employees, one or two part-time employees, and is under the immediate supervision of James H. Stack. In the work of the News Service, communication is highly important. Our brochure "Public Relations for the Chemical Profession" was produced in an attempt to provide practical assistance to the local sections in their efforts to do a better job in publicity and public relations . . . We issue a workbook to the chairmen of the local sections' committees on public relations. Recently we instituted a newsletter, the "P. R. Catalyst," to provide a clearinghouse of ideas on publicity and public relations at the local section level.

Communication to be effective must be a two-way street. It is essential that those in administrative posts know what is in the minds of the members and what the members want the Society to achieve . . . In scientific and professional societies, the governing bodies meet only at infrequent intervals and seldom are their members closely associated with the day-by-day operations.

In turn, there must be a good channel of communication from the governing bodies to the administrative force and to the membership. There must be efficient communication between administrative officers, the membership, local section officers, divisional officers; divisions and local sections.

I have no idea how many million words a year are employed in the way of communication throughout the ACS, but the total would stagger the imagination. Nevertheless, I run into examples where it is obvious that there is a lack of proper communication. At an ACS News Service breakfast, Dr. Milton Silverman, science editor of the *San Francisco Chronicle*, praised the News Service for its disseminating of public information on

scientific progress in chemistry. Then someone at the meeting rose and asked, "Why do we have a News Service? Why should the local sections participate in public relations work?" I explained why, and afterward my associates and I set out to reduce to writing the chief objectives of the ACS News Service.

This illustrates an important point. When the objectives of any organization are set forth in writing, it is easier for each member to understand what is going on, and to evaluate activities in terms of these written objectives . . . In the field of communication nothing can be taken for granted. You cannot rely on the other fellow knowing what is in your mind; nor can you be sure you understand what he is thinking about, unless thoughts are reduced to writing. Even then, there is plenty of chance for misunderstanding or misinterpretation.

There should be ways and means whereby the rank and file of a society can inform officers and governing bodies regarding their wishes. This is where, I think, most societies do the poorest job of communication. One of the most obvious channels is letter writing; another is in the letters to the editor section of the publication of the society. Still another method is a periodic check through questionnairing. More of this could be done in just about every professional society.

Obviously, no society can be all things to all men. Somewhere there must be limitations on activities . . . One can hardly expect uniformity of thinking. Nevertheless, this characteristic of societies complicates the problem of internal and external communication. It is because of the heterogeneity of interests of members that every organization should have specific and written objectives. It is then a simple matter to evaluate any new proposal in the light of these objectives. Without this guidepost, there can be chaos and an unhappy membership. . . .

In a professional society there is a considerable turnover in membership. Therefore, there must be a considerable amount of repetitive material supplied to members, if they are to continue to be informed. Still more must be provided if members are expected to demonstrate initiative, leadership and executive abilities. Every professional society rises or falls depending upon how effective volunteer leadership is in carrying out specific projects and objectives.

No system of communication is perfect. None should ever be static. Therefore, I urge every professional society to have a standing committee on the subject of communication. Most of our professional societies are growing rapidly in membership. What was perfectly satisfactory for the 35 members of the ACS in 1876, would be totally inadequate for its 78,000

members today. The basic objective of a system of communication is to inform. Not infrequently it is confused with such activities as buck passing and building alibies. Think these words over and they will begin to take on greater meaning!

We should not make a fetish of communication. It is a means to an end, not an end in itself. We can have so much that little is used effectively. There must be an intelligent balance. The man who writes a 5-page memo to get information that could be obtained by a telephone call is not practicing intelligently the art of communication.

What we really seek is an informed membership, an active membership participating in society matters. Such activities must be directed to fulfilling the objectives of the society. We might summarize by saying that the primary purpose of communication is to engender constructive team action.

Rarely are societies set up on the chain of common approach so characteristic of the military. Industry — at least our bigger companies — are decentralizing administrative responsibilities and authority. In society circles we have considerable decentralization. When we do, communication takes on even greater importance. More than orders must be issued. Proper communication in a society requires considerable explanatory material, otherwise it will fail to achieve the desired goals. We must combine "what to do" with "why and how." Good member relations is based on a sound premise that you have an adequate program of communication. The ultimate goal is constructive action by members individually and collectively.

A professional society with any sizeable membership is very like a business; to be successful, it must be run efficiently and this demands a modern approach. The difficulties of communication in professional societies are surmountable once a proper attitude of mind is developed by those who have responsibility to help create an informed membership.

Our professional societies could perform much more efficiently if our systems of communications were improved. It is up to each of us as members to do all we can to bring about these desirable results. We are dealing here with a relatively new concept. A railroad president once remarked: "The public be damned." Today's slogan is, "The public be informed." The cost of developing and maintaining proper communication comes high, but it is worth it. It takes planning and it costs large sums. Look at the objectives of the societies you belong to. Are they worth working for? If they are, then the sweat that goes into communication is a small price to pay for their fulfillment.

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Interdisciplinary Communication Among Scientists

Dr. Dwight E. Gray

Program Director for Government Research Information, Office of Scientific Information, National Science Foundation, Washington 25, D.C.

(A condensation of a paper presented at the Second Professional Session, "Communication and the Scientific Professions," at the 33rd AIC Annual Meeting, Boston, Mass., May 11, 1956.)

THE title of this paper is "Interdisciplinary Communication Among Scientists." I shall suggest for your consideration a few ideas, many of them borrowed,(1) which will be in the nature of partial replies to the following queries:

(1) Is it desirable for the scientist in discipline A and the scientist in discipline B to know a lot about each other's affairs?

(2) What kinds of information do they now share, and why?

(3) What are some of the factors that seem to discourage full and free interdisciplinary communication?

(4) What, if anything, should be done about the situation?

Scientists must carefully define terms. *Webster's International Dictionary* has only two definitions of "discipline" that are even remotely pertinent. The first reads, "That which is taught to pupils," and the illustrative example is a quotation from Edmund Spenser, "Fill their books with disciplines of vice." The second definition is, "A subject that is taught; a branch of knowledge; also a course of study." The ointment-immersed insect here is that Mr. Webster labels this definition *Archaic.*

At times we tend to apply the term "discipline" to bodies of knowledge that overlap. Since there is no sharply-defined, universally-accepted dividing line between subject areas that we call disciplines and those that we do not call disciplines, I shall employ the term with different degrees of inclusiveness, but have the context make my usage clear.

Is Extensive Interdisciplinary Communication Desirable? The intellectual curiosity which is a major motivating factor in making a man a scientist is not likely to confine itself naturally to the straight and narrow path of a single discipline, particularly when the fences that bound these paths are man-made, arbitrary and subject to change. Everyone can think of examples of significant discoveries in science that involved bringing together knowledge from

(1) Acknowledgement should be made of valuable suggestions from Dr. H. A. Barton, American Institute of Physics; R. S. Bray, Library of Congress; Dr. Wallace R. Brode, National Bureau of Standards; Mrs. Helen Brownson, National Science Foundation; Dr. Karl Heuman, Chemical Abstracts; Dr. C. E. Sunderlin, National Science Foundation; and Dr. A. F. Thompson, National Science Foundation.

two or more subject fields, major advances that might never have been accomplished without some degree of interdisciplinary communication. Frequently, these have had about them a large element of the accidental. It was said that "Newton was not looking for gravitation when the apple hit him on the head." The following passage is indicative of the ancient and honorable history of the concept that it is important for a man to know something about disciplines other than his own:

Marcus Vitruvius Pollio was a leading Roman engineer and architect under Augustus Caesar. About 27 B.C. in Rome an extensive program of public works was being planned. For the guidance of the Roman master builders, Vitruvius prepared a ten-volume treatise, *De Architectura.* The excerpts below are from a translation by Morris Hicky Morgan (Harvard University Press, 1914):

> The architect should be equipped with knowledge of many branches of study and varied kinds of learning.
>
> An architect ought to be an educated man so as to leave a more lasting remembrance in his treatises. Secondly, he must have a knowledge of drawing so that he can readily make sketches to show the appearance of the work which he proposes. Geometry also is of much assistance in architecture, and in particular it teaches the use of the rules and compass . . . By means of optics, again, the light in the buildings can be drawn from fixed quarters of the sky. It is true that it is by arithmetic that the total cost of buildings is calculated and measurements are computed, but difficult questions involving symmetry are solved by geometrical theories and methods.
>
> A wide knowledge of history is requisite because, among the ornamental parts of an architect's design for a work, there are many, the underlying idea of whose employment, he should be able to explain to inquirers.
>
> As for philosophy, it makes an architect high minded and renders him courteous, just and honest without avariciousness.
>
> Music, also, the architect ought to understand so that he may have knowledge of the canonical and mathematical theory.
>
> The architect also should have a knowledge of the study of medicine on account of the question of climates . . . air, the healthiness and unhealthiness of sites, and the use of different waters . . . And as for principles of law, he should know those which are necessary in the case of buildings having party walls, with regard to water dripping from the eaves, and also the laws about drains, windows, and water supply . . . From astronomy we find the east, west, south and north, as well as the theory of the heavens, the equinox, solstice, and courses of the stars. If one has no knowledge of these matters he will not be able to have any comprehension of the theory of sundials.
>
> Consequently, since this study is so vast in extent, embellished and enriched as it is with many different kinds of learning, I think that men have no right to profess themselves architects hastily, without having climbed from boyhood the steps of these studies and thus, nursed by the knowledge of many arts and sciences, having reached the heights of the holy ground of architecture.

What kinds of Interdisciplinary Communication Now Take Place? The simplest, and probably the most accurate and effective type of scientific communication occurs when one scientist talks or corresponds with another.

If they are from different disciplines, this is interdisciplinary communication. The total amount of such exchange is large and of considerable importance.

The logical next step is one scientist speaking to a number of scientists. Here interdisciplinary communication frequently is involved. In staff seminars, journal club meetings, and the like, which are held in laboratories and science departments, scientists discuss their research programs for the benefit of other scientists, some of whom usually are from other disciplines. It is common for scientific societies to invite men from other subject fields to present papers. Thus physiologists have spoken before optical societies on optics and vision; mathematicians have spoken to chemical groups on design of experiments; chemists and physicists appear before each other's societies to give papers. In fact, this program of the AIC may be said to be practically an orgy of interdisciplinary communication.

The annual Sigma Xi lectures are another channel of appreciable significance in the dissemination of scientific information across discipline lines. Each year, scientists make lecture tours, appearing before Sigma Xi chapters. This year there will be eight such lecturers. Each man speaks to twenty or thirty chapters, pegging his material at a semitechnical level for an audience of broad subject interests. The lectures are published in the society's official journal, *The American Scientist.*

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Among special conferences and symposia are the meetings sponsored by the CIBA Foundation in London (established for the "promotion of international cooperation in medical and chemical research"); the Gordon Research Conferences[2] of the American Association for the Advancement of Science; various symposia of the National Science Foundation, and the Faraday Society symposia.

There are several major scientific journals recognized as important means of interdisciplinary communication. These include, *Science, Scientific Monthly, Nature,* and *Scientific American.* Among the more specialized review journals is the bimonthly *Chemical Reviews.* Other technical journals carry occasional review articles which are worth-while sources of information for scientists in all fields, though there are too few of them. Outstanding in the review book category are the publications of

(2) For detailed description see *Science,* 123, 3192, 357, March 2, 1955.

Annual Reviews, Inc. These include yearly volumes in the fields of biochemistry, entomology, medicine, microbiology, nuclear science, physical chemistry, physiology, plant physiology, and psychology. There is also the British publication, *Annual Reports in Chemistry*.

In addition to these primary publication media, the abstracting and indexing journals can provide extensive guidance to the scientist seeking knowledge in other disciplines. *Chemical Abstracts* has a broad scope of subject coverage.

During 1948-1949, Mr. Robert S. Bray, of the Library of Congress, and I conducted a survey of physics abstracting for the American Institute of Physics. One product of this study was an annotated list of some 150 journals which we called "Abstracting and Indexing Services of Physics Interest."(3) I have noted here the subject disciplines and subdisciplines that were mentioned in addition to physics. There were more than fifty:

> Aeronautical engineering, air conditioning, aircraft engineering, astronomy, biology, bleaching, building science, ceramics, chemical engineering, chemistry — all branches, combustion engineering, documentation, dyeing, electrical engineering, foundry technology, fuels, geology, glaciology, glass technology, industrial arts, industrial hygiene, instrumentation, iron & steel technology, light metals technology, lithography, marine engineering, mathematics, mechanical engineering, medical research, metallurgy, meteorology, microscopy, mining, naval engineering, ophthalmology, painting, petroleum research, pharmacy, photography, plastics & elastics, prevention of deterioration, printing, psychology, railway engineering, refrigeration, road building, seismology, structural engineering, textiles, transportation, and water power.

Allowing for the overlapping terminology used in the identification of these subject fields, this group of abstracting and indexing services, which have some degree of physics interest, actually are worth-while sources of information, or guides to them, in a considerable number of scientific disciplines.

Abstracting in the fields of zoology and petroleum engineering provides a specific example of interdisciplinary exchange of information. The presence of organisms of the order known as Foraminifera is a useful index to oil deposits; consequently, *Petroleum Abstracts* carries references to such zoology papers. On the other hand, *Zoological Record* does not abstract papers on this particular application, indicating perhaps that the literature of the "applied" phase of science tends to be more interdisciplinary than does that of the "pure" phase.

Then there are the bi-disciplinary disciplines like geochemistry, biophysics, paleobotany, geophysics, radio astronomy, and others. I suspect many started from a few original seeds of interdisciplinary communications, which grew to their present produc-

(3) Gray, Dwight E. and Robert S. Bray, *American Journal of Physics, 18*, 5 274-299, May 1950; also can be obtained from the Office of Technical Services, Dep't of Commerce, Washington 25, D.C. as PB-99951.

tive state because scientists in discipline A needed discipline B information. Radio astronomy affords a dramatic recent example of experimentation conducted for a particular purpose in one field that produced an important research tool in another and led to the birth of a new discipline.

Karl Jansky, an electrical engineer with the Bell Telephone Laboratories, was conducting experiments to learn more about the sources of the static that interfered with transatlantic and ship-to-shore radio communication. He became interested in a previously unidentified source of radio noise that seemed to be far out in space. Although radio was his field, he turned to astronomy in his search for the source of this static disturbance. Through his and others' researches, it was found that these signals came from the Milky Way and that they can be used as a powerful tool for the study of astronomical phenomena far beyond the solar system. The so-called "radio-telescope" has a range far greater than that of optical instruments.

Jansky read his first paper on the subject before the Washington meeting of the Institute of Radio Engineers in 1937. Today extensive research programs in radio astronomy are being carried on by many countries. This new field is beginning to show promise in the United States. On April 28th, a new 60-foot radio telescope was dedicated at the George R. Agassiz Station of Harvard Observatory where its operation is supported by the National Science Foundation. A 140-foot instrument may be constructed under the auspices of Associated Universities, Inc. Jansky is reported to have told a colleague that in the early stages of his experiments he found it difficult to interest electrical engineers in his findings because they knew little astronomy and did not see much of use in it, while astronomers, knowing almost no electrical engineering, were indifferent because they believed their techniques adequate for anything they wished to study.

Dr. Karl Heuman, of *Chemical Abstracts,* in connection with these bi-disciplinary areas, suggested that it might be interesting to permute in pairs all the sciences and see what kind of pattern would emerge. I made the test for a set of eight major subject areas: Astronomy, biology, chemistry, engineering, geology, mathematics, physics and psychology. If I assumed AB to equal BA (which

is not always justified), there are 28 possible pairs of which nine represent combinations now recognized as disciplines. These are astrophysics, biochemistry, biophysics, psychobiology, chemical engineering, engineering physics, geophysics, mathematical physics and physical chemistry or chemical physics, depending on the sequence of permutation. (Here, for example, AB obviously does not equal BA.) Some of these clearly do not represent a "marriage" of the two disciplines implied in the name in the same sense that radio astronomy does. There are some 19 unoccupied squares in the grid with which anyone can play around who is interested in starting a new scientific discipline.

One organization, now over ten years old, whose principal business in life is interdisciplinary, is the Chemical-Biological Coordination Center of the National Research Council. It works in the area of broad relationships between chemical structures and biological activities of every variety. Through the use of punched-card techniques, it maintains bibliographic control of this information and answers questions from scientists; it conducts research on techniques of assembling information and making it available. It is unique among information services to the extent in which its mission and reason for existence are concerned with relationships between two disciplines.

A recently established center with interdisciplinary communication implications is the Center for Advanced Study in the Behavioral sciences,[4] Stanford, California, established by the Ford Foundation. Disciplines represented on the first board of directors included psychology, history, economics, sociology, and physics. Each year 50 students of human behavior attend the Center on post-doctoral fellowships.

It is pertinent to mention organizations which have to do with planning, administering or supporting research programs where a number of scientific disciplines are involved. Two are the National Research Council and the National Science Foundation. These agencies are concerned with substantially all fields of science and function both through their multi-discipline staffs and through numerous advisory and policy-making boards, panels and committees, where many fields are represented. The relationship of such an organization to the general scientific health is somewhat analogous to that of a medical clinic to human well being. Whereas the individual scientist or medical specialist may tend to see in every patient symptoms of the ailment that is his specialty, the NRC or NSF type of organization, like the clinic, is able to plan courses of action in proper perspective in the light of composite analysis. Among agencies which

(4) For detailed description, see *Science*, 123, 3193, 405, March 9, 1956.

function somewhat similarly with a limited objective are the American Standards Association and the Scientific Manpower Commission.

Beyond the sponsorship of the Gordon Research Conferences, the AAAS in its activities includes strong elements of interdisciplinary communication by reason of its varied subject groups and meetings. A recent listing shows some 18 sections: Mathematics, physics, chemistry, astronomy, geology, zoological sciences, botanical sciences, anthropology, psychology, social and economic sciences, history and philosophy of science, engineering, medical sciences, dentistry, pharmacy, agriculture, industrial sciences, and education.

The International Council of Scientific Unions from the beginning has had implications for interdisciplinary sharing of knowledge. The astronomer, Dr. George Everett Hale, discussing the origin of ICSU, wrote in July 1932:

> Another important purpose of the Council is to secure cooperation between the Unions in dealing with broad projects, not restricted to particular branches of science. The tendency toward specialization, though useful in assuring intensive work on limited problems, is often disadvantageous, not only to science as a whole, but to the most effective solution of even restricted projects. No one can now pretend to be acquainted with the whole of science but means should be found of giving each specialist as many as possible of the advantages which the most comprehensive knowledge would offer."

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Dr. Hale then cited how the adaptation of a microscope objective lens to the camera of a Mt. Wilson spectrograph resulted in an extension of 50 per cent in the range of the 100-inch telescope.

What Factors Discourage Interdisciplinary Communication? Of the factors that tend to discourage the exchange of information between scientific disciplines, two will be discussed. The first is increasing specialization. Once upon a time, a man was simply a scientist. Franklin and da Vinci wrote and did research with ease in a number of areas now designated as separate disciplines. Thomas Young, known principally for his pioneering work in optics, was a physician, and also experimented in acoustics. But whereas the total quantity of scientific knowledge seems capable of expansion indefinitely, man's capabilities to be conversant with all of it are not. Consequently, increasing specialization has accompanied the rapid growth of the total body of

scientific knowledge. Today, a man may devote his entire research career to one segment of the spectrum. Unquestionably today's scientific specialist knows far more than the great men of the past; but there is so much more to know, that his "index of up-to-dateness" probably is appreciably lower.

One other factor which has seriously interfered with the free interchange of information between disciplines is the imposition of excessive security controls, particularly as related to what is called "need-to-know." This may have stemmed from the failure of the classifiers to recognize certain inescapable facts of life regarding the dissemination of knowledge.

The first such fact is that achievement of complete security control of information is inherently impossible, or prohibitively impractical. The instant an idea is born in the brain of an individual who can speak, write, or make signs, the possibility exists that the idea will be communicated. Absolute security could be approached only by liquidating at an early age every individual capable of having an idea, who was not deaf, mute, blind and paralyzed. No one would favor quite so drastic a security system. We conclude that practical security regulations fall somewhere between the infrared of absolute security and the ultraviolet of no security.

The information security situation resembles that of maintainance of physical security in one's home. We could do much more than we do in the way of protection against possible burglary. We might install very small windows, protect them with steel bars and electric alarms, have but one small doorway with a heavy steel door and a three-combination or time lock, construct all walls of masonry three feet thick, and surround the whole place with a deep moat of water stocked with man-eating sharks. At the other extreme we might have great numbers of unlocked windows and doors. In practice we go beyond the latter but not as far as the former. We protect our homes just to a point such that — consciously or subconsciously — we believe further protection would be more trouble or more costly than it would be worth. In the case of information security, regulations are pegged at a degree of severity below which, in the opinion of the persor. making the decision, the disadvantages of release and open dissemination probably would outweigh the advantages. The tendency has been to make the regulations more severe than strict application of this principle might require, presumably to be on the safe side. There are people who will be disciplined if something is not classified high enough, but there seems to be no one penalized if he classifies something too high or fails to declassify it promptly when the need for

such protection vanishes.

The second fact of security life has to do with the need-to-know aspect. It is that knowledge does not lend itself readily to successful compartmentalization. No matter how carefully one defines the pigeon-holes into which bodies of knowledge are to be thrust, there are always some portions which fit and others which fall on the partitions between the cells. Further, what seems to be a satisfactory scheme for one situation may be completely unusable for many others. This problem has plagued librarians for years. When only subject classification is involved, the worst that can happen is that the searcher for information has to look in more than one place to cover all possibilities. When such a subject breakdown is made the basis for security control, however, the penalties may include extensive duplication of research or complete failure of programs for want of existing knowledge.

As illustration, a committee was charged with maintaining and administering a mailing list in the field of guided missile research. It is obvious that aerodynamics, combustion, guidance and warhead development are among the subject areas involved.

In the beginning, the contractors on the mailing list were divided into groups on a strict need-to-know basis. A few large organizations whose contract responsibilities concerned all phases of the program clearly possessed need-to-know across the board and so were on the list for all guided missile technical reports. But, it was argued, if a contractor is concerned only with the aerodynamics of the missile, why should he have access to reports in any other field? And so his name appeared only on the aerodynamics sub-list. Similarly, guidance contractors were on only the guidance list, power plant contractors on the combustion list, and so forth.

It soon became clear, however, that if the guidance people were to design a satisfactory steering system they would have to know about the air frame being worked on by the aerodynamics group. The same proved true for the combustion contractors. Also if the steering mechanism and the power plant were to fit into the missle, these groups had to know something about each other's work. Further, engine and guidance design both had to be carried out in the light of some knowledge about the characteristics of the warhead. In short, it became clear even to the security people that almost all of the con-

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tractors had a legitimate need-to-know in a variety of the subject categories involved and that the original compartmentalization restrictions would seriously impede progress.

No one favors doing away with all security regulations. If, however, the penalties of excessive security restrictions are to be avoided, those who establish the criteria for classification and for need-to-know compartmentalization must take into account the facts that security classification involves comparing calculated risk with probable gain, and that need-to know limitations based on artificial pigeon-holing of knowledge tend to stifle progress. . .

What, if anything, Should Be Done About the Interdisciplinary Communcation Situation? Efforts toward improving interdisciplinary communication will be realistic only if they are made in full recognition that the total body of scientific information today is so large that few can hope to keep abreast of developments in any substantial number of subject fields. A forced-feeding program of interdisciplinary dissemination of scientific knowledge might attempt to communicate to scientists more information than they needed, and more than they could absorb effectively.

Rather than forced feeding, I would suggest the technique of the buffet supper where a number of different dishes are available to each appetite. One worth-while step would be the publication of many more review articles and books than now appear. *Annual Reviews, Inc.*, has an excellent program and a number of journals carry occasional articles, but more emphasis is needed. Unfortunately, it is one of those functions which we all are convinced someone else should perform. A good review publication can only be written by a person who is highly competent in the subject matter and who can synthesize and unify technical information and present it well. Such people are scarce.

Of greater potential value, would be increased emphasis by abstracting services on covering all aspects of the papers abstracted, and making certain that references to these appear in the service's indexes. In this way one might partially insure against occurrences such as the following which J. S. Bernal has reported.(5) In supporting the thesis that scientists often learn years too late of developments in other fields which might have been useful to them, he pointed out that recent advances in phase and interference spectroscopy depend upon developments in physical optics which are more than 50 years old. However, no one had thought to inform microscopists of what was possible in optics or physicists of what was needed in microscopy.

With regard to security classifica-

(5) Bernal, J. S. "Strategy of Research", *Research*, 8, 456-461, Dec. 1955.

tion, various bases have been suggested for defining sane security standards for scientific information. One proposed by a scientist appearing before the House of Representatives Subcommittee on Government Information[6] is that whenever we stand to gain more than does a potential enemy from the release of information, than that information should be made freely available. An intelligent decision as to what we or they do stand to gain or lose by free exchange of specific information can be made only by individuals who (a) are competent technically to evaluate the information in terms of its probable effects upon and implications for growth of scientific knowledge, and (b) are free to exert their best scientific judgment unhampered by ground rules established by scientifically less competent individuals.

Another scientist at the subcommittee hearings stated that, in his field, our lead over the Soviet world is greatest in areas where information has been most freely available and least where restrictions have been the most severe.

The eminent scientists who participated in these hearings exhibited almost unanimity of opinion on how best to handle information security. They included agreement, first, that care should be taken before classifying knowledge to make certain that such action really is necessary to the welfare of the United States and, second, that the classification procedure should contain a provision to guarantee declassification after the reason for the restriction has ceased to exist. Today, declassification is initiated only upon specific request, and to request that a given document be declassified one must know it exists; if it is classified, one ordinarily does not know this unless he happens to be cleared to see it in its restricted state. To quote Dr. Lloyd Berkner at the hearings:

> "One cannot go to an agency which perhaps has something that should be declassified and say he needs such and such information because he is about to invent or discover something."

The principal mechanism suggested to guarantee an adequate declassification program was to establish, with every classification action, a date after which the document would automatically become declassified unless specific action was taken otherwise. This would have the advantage of placing

(6) Hearings held 7-9 March 1956 by House of Representatives Subcommittee on Government Information, Congressman John E. Moss, chairman.

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the burden of responsibility upon anyone wishing to keep the document classified rather than upon those who may wish to have it released.

As I progressed on this paper, I came upon more and more examples of the import and export of scientific knowledge across disciplinary borders. Altogether it seems to add up to an impressive amount of information exchange. While the situation is not exactly in the point-with-pride category, it does indicate less cause for concern than I had anticipated.

Announced: By Robert A. Stauffer, F.A.I.C., vice president and director of research, National Research Corp., 70 Memorial Drive, Cambridge 42, Mass., the addition of Robert S. Holdsworth as group leader in the Petrochemicals Research Department.

Elected: Dr. Robert S. Aries, F.A.I.C., of R. S. Aries & Associates, New York, N. Y., as a Fellow of the New York Academy of Sciences.

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Announced: By Dr. Johan Bjorksten, F.A.I.C., president of Bjorksten Research Laboratories, Inc., Madison, Wis., that Stuart O. Fiedler has resumed the position of technical director of the Laboratories where he served as vice president and technical director from 1945 to 1947.

Added: To the executive committee of Foster D. Snell, Inc., New York 11, N. Y., Daniel Schoenholz, F.A.I.C., director of the Product Development Department; Dr. Chester A. Snell, F.A.I.C., director of the Analytical Department; Philip B. Ostrow, assistant secretary; Lloyd Osipow, director of Surface Chemistry Department, and Richard L. Moore, F.A.I.C., assistant treasurer and director of personnel and public relations.

"In looking back over the past thirty-five years, I am amazed at the growth of what has come to be known as the petrochemical industry in the U.S. . . . Prior to the 1920's, we had an organic chemical industry but it was small. The total sale of (these) chemicals amounted to only fourteen million pounds as against 3.2 billion pounds at the present time. Furthermore, many of the chemicals, such as acetone, acetic acid, and methanol, were made by processes that did not even faintly resemble the present processes."

—Joseph G. Davidson

Communication and Participation in the Community

Dr. Charles C. Price, F.A.I.C.

Director, Department of Chemistry, University of Pennsylvania, Philadelphia 4, Pa.

(Abstract of a talk presented at the Third Professional Session, "Communication and the Individual Professional Man," at the 33rd AIC Annual Meeting, Boston, Mass., May 11, 1956.)

THE chemist, as a professional man and a scientist, has a major responsibility to the commnuity in which he lives, at the local, national and world levels. The chemist should understand the tremendous impact science has had on all aspects of these communities of which he is a part. The progress of science has brought dramatic changes to our economy, our politics, our military affairs, and even our social customs, and promises even more dramatic changes for the future. Chemists are, by a large margin, the most numerous of all natural scientists, and therefore have a particularly important share in the responsibility which must go hand-in-hand with our accomplishments.

It is necessary for us to accept some responsibility far beyond the narrow confines of our science and our profession. What we do as scientists has a profound influence on the community we live in, and the collective decisions of the various communities in which we live can have an important influence on our activities. It is a basic concept of democracy that decisions to be made, or at least influenced by the people, can be intelligent only if the public is educated and informed. It is therefore a major responsibility of the scientist to help in every way possible to bring the basic facts to the people and especially to those responsible for decisions affecting the welfare of the community.

This should not be done with the attitude that we are an intellectual elite but simply on the basis of the fact that we have an understanding of an important factor which vitally affects the lives of our fellow citizens. There are many ways in which this can be done at the local level, for example, by radio and TV shows of science in action, and talks by scientists to lay groups. One particular way which seems especially important is to participate in forming educational policy in the local schools. By actual participation on school boards, or by expressing our views in other ways, we should make it clear to our fellow citizens that vigorous and stimulating education of the small group who will become the scientists of the future is an essential for progress and security. Just as the physically gifted boys are selected for the athletic squads, the vocally-gifted for the glee

clubs, so must the intellectually gifted be selected for the most challenging possible educational program.

At the state and national level, the scientist needs to communicate the needs of science to the community in order to obtain adequate support for basic research. This is growing through such agencies as the National Science Foundation, the National Institutes of Health, as well as private agencies. It seems regrettable that the main stimulus has come from the challenge of Soviet science — but then perhaps this is only an added indication of the value of competition in stimulating progress. It is important for us to see that the community is aware of the great benefits from scientific progress entirely apart from the Soviet threat to our military security. We must make clear to the people the necessity of free exchange of scientific ideas, as contrasted to the security necessary for military applications.

In the international community also, there are increasing opportunities for scientific endeavor. The World Health Organization, the Food and Agriculture Organization, and the nascent UN Agency for Peaceful Uses of Atomic Energy, are all examples of world-wide activities with strong scientific aspects. Senator Anderson (D., N.M.) recently proposed that some important areas of science, such as nuclear power and weather control, be developed in international laboratories, partly because such progress would have important international repercussions and partly because future scientific discoveries in secret national laboratories might upset the present "stalemate" and tempt an aggressor to instigate a disastrous war.

The scientist also has a responsibility to the community since he should have a deeper understanding of the potentials of nuclear weapons, intercontinental missiles and bacterial warfare, to name a few. It should be more obvious to scientists than to most citizens that we need to eliminate the threat to our entire civilization which these weapons of mass destruction pose. We should express most vigorously the need for a ban on tests of nuclear weapons, while there are still only two major atomic powers. The problems of inspection and control and the dangers of miscalculation will be vastly increased if many powers develop atomic armaments. The major advantage of a ban on nuclear tests is that it can be so easily monitored without the need to violate national boundaries.

It would also be desirable to seek to establish an effective ban on all tests of long-range missiles as well. Now, before any nation has had a chance to develop and stockpile such awesome weapons, it would be possible to set up a series of radar picket stations, to be manned by UN personnel, which could detect any breach of such a test ban.

These bans on nuclear and ICBM tests would at least bring a halt to the most terrifying aspects of the arms

race and give us the time and help to create the atmosphere necessary to work toward a more fundamental solution. They would represent an important step toward the ultimate goal of universal and complete disarmament, with all national military establishments turned over to control by a duly constituted UN agency for conversion to peace time use or for scrapping, with some held as a safe deterrent to any would-be aggressor.

These steps would represent an important improvement in the security of the American people. I hope we will accept our responsibility by helping to communicate to the people the scientific "facts of life" which make this so.

Communication as a Factor in Success or Failure on the Job

Dr. S. D. Kirkpatrick, Hon. AIC

Editorial Director, Chemical Engineering and Chemical Week, 330 West 42nd St., New York, N. Y.

(Presented at the Third Professional Session, "Communication and the Individual Professional Man," at the 33rd AIC Annual Meeting, Boston, Mass., May 11, 1956.)

IN the forty years since I graduated in chemical engineering from the University of Illinois, there has never been a time when there were more opportunities for leadership in the chemical industry and profession. Today's complicated civilization depends on leaders who can guide and coordinate the forces of science and industry. Unfortunately, however, the increasing needs for intensive specialization in training and experience make it difficult to find technical men who are proficient in their own fields and at the same time well grounded in the broader phases of business and human activity.

This situation poses a problem for industry which is equally important to us as individuals. Our companies, when they can, selectively recruit young men with aptitudes and training to become specialists. They start them at the bottom of the ladder, and the higher they climb the more specialized they become. The result is a vertical channelization of industry with mental if not corporate barriers to something we talk a lot about nowadays — cross fertilization of ideas. In essence, this is a problem of communication.

I am not going to make a plea for more generalists and fewer specialists. What we all want to see are technical men better equipped to get more fun and satisfaction out of their lives as well as their jobs. Even the man with the narrowest specialty can greatly broaden the field of his personal in-

fluence and professional effectiveness by studying and mastering the neglected arts of communication. Often this is just a matter of finding time for these extra-curricular activities. Sometimes it is a lack of willingness to face the facts and persevere in a program of self-improvement.

In this connection, I am reminded of a story Dr. H. C. Parmelee likes to tell about his predecessor, the first editor of the old "Chem. & Met." Dr. E. F. Roeber was a native of Germany, as were many of our chemical leaders before World War I. He spoke English with a heavy Teutonic accent (and construction) but his writings were clear, forceful and precise. Here is the secret of his accomplishment: One of the great newspaper editors of that day was Charles Dana of the old New York *Sun*. Roeber was his ardent reader and admirer. So every night, he would take one of Dana's editorials, carefully translate it into the best German at his command, and then put it away. A month later he would take it from the files and translate it back into the best English he could command. Then by comparing his re-translation with Dana's original, he could spot his own faults and weaknesses and do something about them. The result was that Roeber's own editorials are classics today that still serve as models for some of our junior editors (or at least they did before editorials went out of style).

Another old friend and great admirer of Dr. Roeber was Dr. Leo H. Baekeland who by self education also became a past master of written, if not oral communications. Another in our generation is Dr. Rudolf Flesch, the German-born student of Lyman Bryson at Columbia who has become a final arbiter on the readability of English text. You can well afford to read "The Art of Plain Talk." I do not say you'll agree with Dr. Flesch in all his conclusions but I'll guarantee that this little book will help any of you in your daily work.

I think you will agree that there is no more pleasant way to improve on our deficiencies than in studying the qualities of good literature.

Part of my assignment is to give you some success stories, of how chemists have lifted themselves by their own bootstraps to influential positions in our industries and professions. In earlier days I was honored by being the first publishers of the edited writings of several of the gentlemen who share our program. At the risk of some embarrassment to some of them I might let you know that in the early days I had the privilege of professionally advising that polished proponent of the Harvard Classics, Francis J. Curtis. And even the great Dr. Donald Babcock Keyes allowed me to polish off a few of his less brilliant but perhaps more pungent figures of speech. I had less trouble with Larry Bass because of the tutelage he received from Dean Hamor of Mellon Institute. And I have long worshipped

at the same shrine as Ray Stevens and Arthur (Bud) Fisher. I need point only to the enduring classics of Arthur D. Little to make my point, that convincing communications and ever widening influences are concommitants of success.

A certain young chemical engineering graduate of Massachusetts Institute of Technology came down to work for McGraw-Hill in the 1920's. I say "down" to McGraw-Hill advisedly because this young man had somehow got the impression that that was the only way you could go after leaving the cloistered Temple of Knowledge on the Charles River at the Hub of the Universe.

In those days we used to have "bull sessions" that we called editorial staff meetings each week. I was surprised to find this young man, almost at the start, taking notes and later he would put them on the dictaphone. In an open office I could not help hearing my own name mentioned occasionally, so I asked to see a copy of the dictated notes. They read pretty well. Some of the things I was reported to have said sounded quite erudite. So I suggested that the young man become our recording secretary and circulate his notes to all the staff — including the big bosses up in the front office. They proved useful points of reference in further discussion and before long our young secretary was preparing agenda for all our meetings. In Dr. Parmelee's absence he even served, in effect, as our acting chairman.

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About that time Dr. Parmelee, Arthur D. Little, Warren K. Lewis, L. H. Baekeland and five or six other chemical engineers from industry or education had been holding a series of meetings to outline plans for starting a Chemical Engineering Series of Text and Reference Books. I had been secretary of that committee and took some pride in helping Dr. Parmelee discuss these plans with my fellow editors. We were looking for authors and I recall that when we came to the subject of chemical engineering economics, I was about to remind everyone of my own extended experience with the United States Tariff Commission, the Census Bureau and other governmental agencies. But before I

could make my little speech, the young man from MIT spoke up. He recalled that he had taken Prof. W. K. Lewis' famous course on "Economic Balance" and had all his notes in shape for publication, that he had learned a lot in his work with us and hoped all of us would help him organize some of the material we had prepared for the magazine. There was nothing for us to do but wish him luck.

But he did not need it. After working hard Saturday afternoons and Sundays, he came in with his notes and dictated a rough draft for a couple of chapters. The copy would be passed around among us for correction and suggestions. In three or four months the whole manuscript was ready for the printer and in another six months, McGraw-Hill published "Chemical Engineering Economics" by Chaplin Tyler, the third assistant editor of *Chemical & Metallurgical Engineering*. He gave each of us an an autographed copy and showed us where he had mentioned our names in the preface and in various footnotes.

This was not the best book in the world, but being the first of its kind, a lot of folks bought copies. Among them was Roger Williams, Sr., of DuPont's Ammonia Department who called up Dr. Parmelee one day and told him he would like to meet the young man who had written that book. He did, and the rest of my story of Ty's success has been written in Wilmington, Del. Thanks to his ability to think and write clearly (they go together!) he has climbed to a high place in DuPont's Development Department, the mental aristocracy of that great aggregation of men, money, and brains.

That's all for the success stories. You and I have also seen the other kind. In fact, I cannot think of anything more tragic than seeing a man who could really make a great contribution to society, to his company and to himself, but who fails to find a medium for its expression when the opportunity arises. Too often he is a licked man. From then on he will either withdraw into his own shell or settle down into a more or less comfortable rut. He will stay there as long as he remains in the profession. And was it not Harry A. Curtis of TVA who says a rut is just a coffin with the ends knocked out?

There is urgent need in industry today for men and women who have developed their abilities to write and speak clearly and convincingly. No matter what work a man may undertake that ability can be worth many thousands of dollars to him over the years.

When a man cannot convey his ideas to other people, he limits himself to what he can do alone. He is on his own. Yet today very few important achievements in industry result from individual effort. Teamwork is essential and the very basis of teamwork and leadership is the communication of ideas.

Opportunities

Doris Eager, M.A.I.C.

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Also see page 221

Chemists Available

Food Technologist seeks position. Excellent qualifications and experience. M.S. and Ph.D. in organic chemistry. Languages. Box 60, THE CHEMIST.

Will You Come

June 7, 1956. New York Chapter. Annual Dinner Meeting. Hotel Commodore, New York, N. Y. Presentation of Honor Scroll to Dr. Charles N. Frey, consultant and lecturer, Massachusetts Institute of Technology, Cambridge, Mass. Speakers: Dr. R. R. Williams (his paper to be presented by Dr. Randolph Major); Richard L. Moore, Dr. Wayne E. Kuhn. Acceptance address, "Coordinating Fundamental and Industrial Research," Dr. Frey.

June 14, 1956. Washington Chapter. O'Donnell's Sea Grill. Washington, D. C. Luncheon. Annual Business Meeting. Election of officers.

June 15, 1956. Chicago Chapter. Annual Meeting. Election of officers.

June 20, 1956. AIC National Council and Board of Directors. Dinner Meeting. The Chemists' Club, New York 17, N. Y.

May 22-24, 1957. Thirty-fourth Annual Meeting. The American Institute of Chemists. Sheraton-Mayflower Hotel, Akron, Ohio.

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Elected: As president of the Association of Consulting Chemists and Chemical Engineers, Inc., 50 E. 41st St., New York 17, N. Y., Carl Bussow, F.A.I.C., of A. W. Dow, Inc., New York, N. Y. Dr. Foster Dee Snell, F.A.I.C., of Foster D. Snell, Inc., New York, N.Y. was elected vice president. Dr. Joseph W. E. Harrisson, F.A.I.C., of LaWall & Harrisson Laboratories, Philadelphia, Pa., and Percy E. Landolt, F.A.I.C., of Landolt & Whitney, New York, N.Y., were elected councilors.

Quoted: In *Science Digest,* April 1956, page 30, some comments by Dr. Henry B. Hass, F.A.I.C., from THE CHEMIST, December, 1955.

Recruitment Program

Dr. J. C. Warner, Hon. AIC, speaking before the Southeastern Regional Meeting of the American Chemical Society in November, suggested the following recruitment program to obtain more and better high school science teachers:

(1) Science teaching in the schools should be made more attractive by substantial increases in the salary scale.

(2) Science teacher certification requirements should be revised to place more emphasis on the understanding of science and less emphasis on training in pedagogy.

(3) Effective science teachers should be awarded more public acclaim and prestige in their communities.

Opened: By Truesdail Laboratories, Inc., Los Angeles, Calif., an operating division laboratory in Honolulu, Hawaii. Dr. Roger W. Truesdail, F.A.I.C., president, states that arrangements have been made to lease space in a new building being erected by Hawaii Chemical Co., Ltd.

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KEEPING UP WITH JET AIRPLANES?

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Some of the same type of engineering development work, which produced jet airplanes and such sensational progress in the aviation industry, has been done on various types of stationary jets. While results are not as spectacular, improvements have been even greater percentage-wise in some smaller industries.

For example, the jet heater, working at very high velocity, possibly on corrosive liquids, will cost a very small fraction of the price of a surface heater. When designed properly, the heater can also raise the pressure of the liquid substantially and completely eliminate one or more pumps, which can be quite expensive if made from special materials.

A jet absorber is another good example. In some cases, a unit the approximate size of a man's arm can take the place of an absorption tower 3 feet in diameter and 10 or 12 feet high, with tremendous savings in first cost and no increase in operating cost. The absorber can literally supersaturate a liquid with a gas by discharging at a higher pressure than desired. Equilibrium is then established by reducing the pressure and liberating some gas, leaving a completely saturated solution at any desired pressure within certain ranges.

Of course, progress has also been made in efficiency and dependability of the best known application of industrial jets, which is steam jet vacuum equipment and vacuum refrigeration. Information on any of this type of equipment is available on request.

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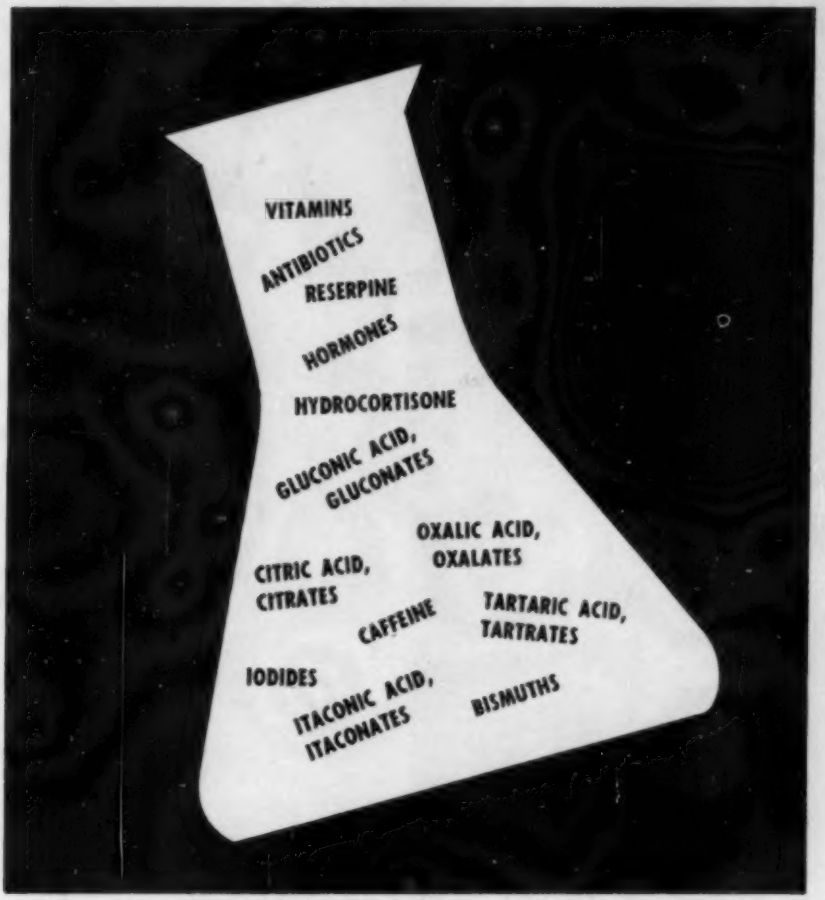

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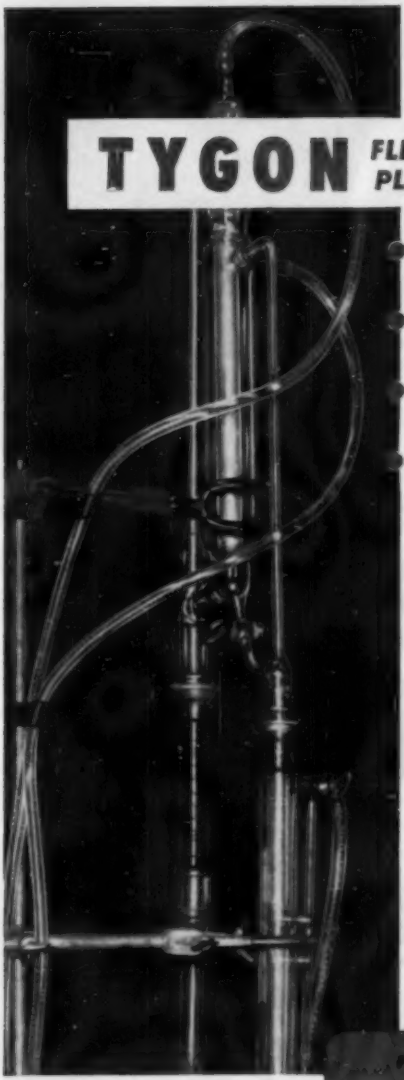

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